NOLAN, CARSON Y.

Instructional Materials Reference Center for Visually Handicapped Children

FINAL TECHNICAL REPORT -- Section 1

November 30, 1974

Project No. 272036
Contract No. 720E7163, OEG 2-6-062289

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FINAL TECHNICAL REPORT
Edited by: Carson Y. Nolan and Amie L. Dennison

PROJECT NO. 272036
CONTRACT NO. 720E7163, OEG 2-6-062289 - 1582

Carl W. Lappin, Director
IMRC/APH
AMERICAN PRINTING HOUSE FOR THE BLIND
1839 Frankfort Avenue
Louisville, Kentucky 40206

INSTRUCTIONAL MATERIALS REFERENCE CENTER FOR VISUALLY HANDICAPPED CHILDREN

November 30, 1974

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education
Bureau of Education for the Handicapped

ABSTRACT

This report details the reference and research, and development activities of the American Printing House Instructional Materials Center from 1966 through August 1974.

The reference activities described encompass materials reference services, publications and distributions of special materials for teachers of the visually impaired. In addition, the lending service for special materials for teacher use is delineated.

Research and development activities are described for the areas of science, mathematics, social studies, sensorimotor readiness, multihandicapped education, braille reading, educational measures and others.

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U.S. DEPARTMENT OF
HEALTH, EDUCATION AND WELFARE
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TABLE OF CONTENTS

		Page
Section I		
Introduction		1
Chapter 1	Reference Services	4
Chapter 2	Publications and Information Distribution	5
Chapter 3	Lending Services: Materials for Prescriptive Teaching and Non-Prescriptive Aids for Utilization of Low Vision	14
Chapter 4	Educational Materials Development	27
Chapter 5	Development of Science Materials	31
Chapter 6	Development of Mathematics Materials	94
Chapter 7	Social Studies Materials Development	151
Chapter 8	Development of Sensorimotor Readiness Aids	207
Chapter 9	Adaptation of Material for the Multi-Handicapped Visually Impaired	238
Chapter 10	Development of Braille Reading Materials	277
Chapter 11	Adaptation of Educational Tests	323
Chapter 12	Other Material Development	340
Section II		
Appendix A	References	
Appendix B	List of APH Items	
Brochures of APH Items Developed or Modified by IMRC Personnel		

INSTRUCTIONAL MATERIALS REFERENCE CENTER

American Printing House for the Blind
Louisville, Kentucky 40206

INTRODUCTION

The need for relevant educational materials, instructional and supportive devices for the visually handicapped was recognized more than a century ago. The American Printing House for the Blind (APH) through the years has served as the principal agency in the attempt to meet that need. In 1966, the Instructional Materials Reference Center for Visually Handicapped Children (IMRC) was established under Title III Provisions, Section 302 of Public Law 88-164. The stated purpose was "to serve as an information source concerning available materials and as a development and evaluation facility for materials ...not available." The American Printing House was to provide housing and assume costs of operation when necessary.

Approximately 1500 square feet of space in the administrative wing was made available and remodeled for housing the data storage and dissemination function, the evaluation function and storage of materials. In addition, 600 feet of space was made available and outfitted to house the development function (Model Shop).

With new plant expansion in 1973-74, the IMRC's Model Shop was moved into an area designed for its needs. The initial 600 feet of space was expanded to 1800 feet, tripled in size. The additional area was much needed for the equipment provided for more efficient work in the development of prototypes.

The Center was established as an additional department within APH, interrelating with other departments of APH, including production, recording, editorial, data processing, and educational research.

Since its establishment, the Center's housing in the administrative wing of APH has been moved so that its staff now has use of additional space in APH's newly constructed facilities. In addition to the original 1500 square feet, 1200 square feet formerly occupied by the Educational Research Department and 3600 square feet of newly built space combine to house the overall inter-functioning Educational Research, Development, and Reference Group at APH. This unit of space provides more adequate offices for the staff of the IMRC, work rooms, laboratories, library, conference room, and offices for expanded research staff.

The Center's unique function as a department within APH gives it added resources. The Editorial Department is directed by a world recognized expert in braille and in the tactual codes for mathematics and music. The Production Department has capabilities in large type and braille printing, binding, and manufacturing in plastic, wood, or metal.

The Recording Department has the means of making high quality recordings and reproducing them on disc and both open reel and cassette tape. Complete apparatus for speech compression is available. A small electronics shop is maintained. The Data Processing Department has a full force using both the IBM 360/20 and the IBM 7040.

The above do not touch upon the resources within the Educational Research, Development, and Reference Group which consists of fifteen professionally trained and six supporting staff members.

From the ex officio trustees of the APH, three standing committees made up of five members each serve in an advisory and evaluative capacity for the Center and APH. These administrators who are responsible for the educational services for the visually handicapped in all facilities (public, residential, private, parochial) in their individual states suggest action, cooperate in studies and evaluations, and make final recommendations concerning products which APH will produce. IMRC meanwhile does use some of its resources to facilitate interim steps and services as they are deemed of value.

Through its research internship program, the Center relates to teacher training programs. This interrelationship is particularly close with the program at nearby George Peabody College resulting in a variety of collaborative efforts over the years.

Relationships with school programs are being continually defined and strengthened. This is particularly true of the Kentucky School for the Blind which is next door to the Center and the nearby residential schools in Indiana, Ohio, and Tennessee. Personnel from all of these schools are very deeply involved in research and development projects. Through its periodic institutes, held to define materials problems in the various curricular areas, the Center involves in its activities, both public and residential school teachers from across the nation.

In its Demonstration Design, the IMRC proposed to: (1) provide a single National source of information about the availability of educational materials, (2) provide a program for...development of needed materials, (3) provide means of communicating and demonstrating the availability and methods of use of such materials to educational programs and teacher training facilities. These goals might be reached through the already established contacts with: (1) state departments of education, (2) residential schools for the visually handicapped, (3) volunteer groups producing materials for the visually handicapped. It was further proposed that these groups, particularly the first two, would provide a base for an evaluative process. Plans were projected for including teacher training programs and in-service information - sharing through displays, exhibits, consultative and other means as opportunities developed.

The Continuation Proposal, prepared for September 1969, presented specific goals which were both summary of achievement and projection of plans in some detail. Plans and the initial steps for providing needed math and science materials were indicated, readiness projects (pre-school level) were reported, and the increasing interaction between Center personnel and teacher training programs was pointed out. Particularly noteworthy was the inclusion of "An APH/IMC Educational Materials Evaluation System" which details the system used to safeguard the standards of work in this area.

Quarterly reports and annual reports have indicated that proposals are carried forward. Staff positions as originally planned, were changed and expanded as needs were shown. APH has provided additional housing and facilities to make needed changes feasible. Budgetary adjustments have been made to achieve the most for those we attempt to serve, as we are able to judge. Responses in terms of requests for services both reference and consultative continue to grow as indicated in quarterly reports. Materials available on loan is an added service which has been received well. (Chapter 3 of this report gives summary information regarding this service.)

The proposals and grants have in all instances indicated that the IMRC would:

(1) Continue to be a national reference center and clearing house for textbooks, supplementary books, and commercially available materials for use in educating visually impaired children in the United States.

(2) Continue to discover, adapt, develop, and evaluate new materials for the education of blind children and youth. Special attention will be given to the needs of deaf-blind, multi-handicapped blind, and pre-school visually handicapped children.

The Instructional Materials Reference Center at the American Printing House for the Blind has continued to work towards its two original primary goals. First, this Center has continued to be the national reference center and clearing house for textbooks, supplementary books, and commercially available materials for use in educating visually impaired children in the United States. The Center files do include materials of an educational nature for pre-school through the college level student. Braille, large type, recordings, and tangible aids are catalogued and references are given. Second, the Center continues to discover, adapt, develop, and evaluate new materials for the education of blind children and youth. The needs of deaf-blind, multi-handicapped blind, and pre-school children do receive special attention. Once such materials are perfected, they are produced and distributed by the American Printing House or some other appropriate source.

Contract proposals have described the strategies necessary to meet the objectives implied by these two goals of the Center. Projections of expenditures to attain these objectives have been made by objective or by strategy as appropriate. Breaking costs at the strategy level, in some cases, did not appear practical.

CHAPTER ONE

REFERENCE SERVICES

The Instructional Materials Reference Center (IMRC) was developed and is still maintained to provide educators of the visually handicapped and related personnel with ready references to valid materials and information pertaining to the education of visually handicapped children. The Central Catalog of Volunteer Produced Books is an integral part of the workings of IMRC. A comprehensive listing in card file form, the Central Catalog lists titles of books in braille, large type, and recorded form.

Those who produce this material register their intention to do so and request clearance from IMRC. The IMRC checks its files for duplication of effort and so informs the one filing the intention. This helps to eliminate needless waste of time and effort. When materials are required, students, parents, teachers, and other professional workers as well as paraprofessionals contact the IMRC by telephone, wire, or mail to learn where such materials are available. Such requests may be for one title or for more than a hundred titles. IMRC's staff is dedicated to keeping the Central Catalog up-dated and to giving immediate response to all requests.

The summary figures, taken from records kept from Fy '70 forward and given below, give some insight into the amount of activity involved in maintaining this reference service.

These figures relate to general reference information concerning the education of the visually handicapped as well as textbook material from commercial and volunteer sources. An annual print-out of the Central Catalog distributed to the larger installations of users keeps the day-to-day reference load at a manageable level.

REFERENCE SERVICE	Fy '70	Fy '71	Fy '72	Fy '73	Fy '74 (15 mos.)
Requests	5,786	4,896	4,934	4,930	6,201
Replies		6,247	6,189	6,115	6,064
CLEARANCE FOR MAINTENANCE					
Intentions received	11,156	11,278	10,858	10,521	12,699
Completion reports	11,000	12,196	12,848	12,360	12,909
a. Typed for C.C.	7,555	9,403	9,156	8,733	
b. Forwarded to L.C.	3,445	2,793	3,692	3,627	1,855

CHAPTER TWO

PUBLICATIONS AND INFORMATION DISTRIBUTION

In addition to the Reference Service which was summarily reported in the previous section, the IMRC was mandated to provide:

A. A national source of information about availability of educational materials from all sources.

B. A program for the energetic and systematic development and evaluation of needed materials.

C. A means of formally communicating and demonstrating the availability and methods for use of such materials to educational programs and teacher training facilities.

To those objectives, the IMRC from its origin has responded along three direct personal lines. Materials which could be of immediate and/or long range assistance were searched out, produced, and distributed. These ranged from one-sheet source lists to original handbooks written by IMRC staff and numbering more than one hundred pages. Copies of each were sent to the Network Office at the time of production and again in May of 1974 to the Network Office and to George Washington University. In the figures given below, only titles and distribution figures are indicated.

A second line of response from IMRC to its objectives was the staffing of field trips to teacher training programs, special workshops, in-service groups, conferences, and institutes of a special nature related to the education of the visually impaired. Requests for special help from agencies, state departments, and residential installations were responded to with no selectivity in an effort to be of assistance to all who recognized their need. The figures shown below give only summary information of actual time spent on the spot. Planning and travel time as well as multi-staff involvement are not indicated.

The third direct personal line which has made a contribution toward achieving the objectives has been assuming the responsibility for all "professional visitors" to the American Printing House for the Blind (APH). It was felt that the man-hours required would be helpful in making known the role of the IMRC and in having IMRC personnel make face-to-face contact with professional workers in the field of the visually handicapped. This third approach varied from unplanned "drop-in" tours of as few as one teacher, to advance notice for a group of fifteen foreign educators being hosted by the Office of Education, to pre-planned in-service conference/workshops of teachers from a state and/or an educational institution.

This hosting and coordinating has been recognized as helpful and therefore is included in annual planning by such groups as the Kentucky Special Education State Teachers Meeting and College Teacher Training Programs from Tennessee, Illinois, and Indiana. Summary figures are included here to review the impact.

MATERIALS PRODUCED AND DISTRIBUTED BY THE IMRC/APH

Items are listed here under the fiscal year against which they were charged when produced and/or reproduced. The distribution has always been free of cost to the recipient and has been continued until the supply was depleted, with no restraints on the users. An assurance of purpose without waste was the only request made by the IMRC. Quarterly records by title and exact numbers of the current distribution have been consistently made to the Network Office.

June 1, 1966 - August 31, 1968

Instructional Materials Reference Center for Visually Handicapped Children --- Member of IMC Network	1000
The Central Catalog of Volunteer-Produced Textbooks and Children's Literature Books, by Carl W. Lappin	1000
Central Catalog, 1st Edition (subject listing)	500
Large Type Source List	3000
Large Type Reproducers Lists	1000
Sources of Materials for the Partially Sighted	5000

September 1, 1968 - August 31, 1969

Central Catalog, Supplement to 1st Edition	500
Bibliography Regarding Preschool Visually Impaired Children	200
Educational Aids for Visually Handicapped	1000
Instructional Materials Reference Center for the Visually Handicapped, by Carl W. Lappin	1500
Recorded Materials List	3000
Commerical Aids That May Be Used or Adapted for Visually Handicapped	2000

September 1, 1969 - August 31, 1970

Central Catalog, 2nd edition (subject listing)	500
Large Type Reproducers Lists	2000
Handbook for Teachers of the Visually Handicapped, by Napier & Weishahn	6568
The Visually Impaired Child: Growth, Learning, Development, Infancy to School Age, by Carol Halliday	5000
Utilization of Low Vision: Bibliography and Materials List	1000

September 1, 1970 - August 31, 1971

Central Catalog, 3rd edition (title listing)	750
Multiply Handicapped Visually Impaired Children: Instructional Materials Needs	300
Commercially Available Recorded Instruction Materials for the Development of Communication Skills	3093
Educational Aids for Visually Handicapped	2424
Materials Reference List	1672

September 1, 1971 - August 31, 1972

Central Catalog, 4th edition (title listing)	500
Sources of Materials for the Partially Sighted	1000
Recorded Materials List	1000
Commercial Aids That May Be Used or Adapted for Visually Handicapped	1000
Commercially Available Instructional Materials for Use in the Development of Elementary Readiness Skills in Young Visually Handicapped Students	3000
IMRC/APH Publications	1000
Educational Aids for Visually Handicapped	1000

Commercially Available Recorded Instructional Materials for the Development of Communication Skills	1000
Bibliography of Research on the Visually Handicapped, 1953-1971, by June E. Morris & Carson Y. Nolan	1000
Non-Prescriptive Low Vision Aids Available on Loan	2000
At Your Service: the Instructional Materials Reference Center for the Visually Handicapped, by Carl W. Lappin	242

September 1, 1972 - August 31, 1973

Central Catalog, 5th edition (title listings)	500
Aids for Teaching Basic Concepts of Sensory Development, by Barraga, Dorward, and Ford	5000
Educational Aids for Visually Handicapped	500
Commercially Available Instructional Materials for Use in the Development of Elementary Readiness Skills in Young Visually Handicapped Students	1000
Sources of Materials for the Partially Sighted	1000
Materials Reference List	1000
Recorded Materials	1000

September 1, 1973 - November 30, 1974

Central Catalog, 6th edition (title Listings)	500
Guide to Effective Study Through Listening: Aural Study Systems for the Visually Handicapped, by Nolan, Brothers, and Morris	3000
Creative Arts and Crafts for Children With Visual Handicaps, by Sykes, Watson, and Menze	6000
Handbook for Teachers of the Visually Handicapped, by Napier, Kappan, Tuttle, Schrotberger, and Dennison	10000
A Guide for Social Competency: Course of Study for the Visually Handicapped, by Mae E. Davidow	10000
Materials for Prescriptive Teaching for Utilization of Low Vision	1000

FIELD TRIPS STAFFED BY INSTRUCTIONAL MATERIALS REFERENCE CENTER PERSONNEL

June 1, 1966 - August 31, 1968

Director and one additional staff member spent approximately 134 days in conferences, in-service programs, workshops, and teacher training programs.

September 1, 1968 - August 31, 1969

Director and four additional staff members worked in twenty-three summer teacher training programs with 1,011 students enrolled in classes concerned with the problems of educating the visually handicapped.

September 1, 1969 - August 31, 1970

Director and staff distributed materials, gave slide talks, and made presentations regarding American Printing House for the Blind, Instructional Materials Reference Center, and Special Education Network as related to the education of the visually handicapped in thirty teacher training programs. Two state department sponsored in-service programs, three special interest conferences and two national week-long conferences brought the work days to over 155 for the year.

September 1, 1970 - August 31, 1971

Thirty-seven field trips, averaging three days each were made to half the continental states, many of them more than once for different kinds of coverage.

September 1, 1971 - August 31, 1972

Twelve college training programs, state departments of special education, as well as national conferences of the American Association of Workers for the Blind, the National Braille Association, the Association for the Education of the Visually Handicapped, the Council for Exceptional Children, and the Library of Congress were served by the IMRC staff through exhibits and presentations made concerning the educational needs of the visually impaired. In addition, a state-wide in-service conference for teachers of the visually handicapped was provided an exhibit and presentations for a two-day program.

September 1, 1972 - August 31, 1973

Director and IMRC staff averaged three days per month in field service through teacher training programs, in-service sessions, conferences, and workshops. Again these activities encompassed the nation. Interface planning, evaluation of residential program, and serving in advisory capacity for the establishment of a touch gallery in a museum were additional tasks undertaken in the area of felt needs and field services.

September 1, 1973 - November 30, 1974

Some thirty field trips, averaging three days per trip, made by the IMRC director and two other staff members were similar to previous years. Additionally, a traveling display was provided. Items developed through IMRC/APH efforts as well as other items available for use in educating the visually impaired were carried into five educational settings in three states in one swing tour. In this way teachers were able to see and handle products instead of making decisions based on reading brochures. The response was excellent. This was done with NO extra funding for a specially fitted van or carrying vehicle and seemingly worked adequately.

SUMMARY FIGURES OF PROFESSIONAL GROUPS HOSTED BY IMRC PERSONNEL

(GUESTS AT APH)

June 1, 1966 - August 31, 1968

No records kept.

September 1, 1968 - August 31, 1969

Students from Teacher Training Programs:
- George Peabody College - 18
- Univ. of Kansas - 4
- Hunter College - 8
- Univ. of Tennessee - 8
- W. Michigan University - 20

Teachers: (of Visually Handicapped)
- Tennessee - 16
- Iowa Residential School - 2
- W. Michigan - 1
- Toronto, Canada - 3

Administrators & Consultants:
- George Peabody College - 2
- Tennessee - 16
- Kentucky State Dept. of Education - 3

September 1, 1969 - August 31, 1970

Departments of Education - 4 states, 9 staff members

Associations for the Blind - 2 associations, 5 members

Materials Centers - 2 centers, 3 staff members

Volunteers - 7 organizations, 17 workers

Schools for the Blind - 4 schools, 25 teachers and house parents

College Groups - 9 colleges, 110 students and teachers

World Travelers - 2 countries, 3 individuals

September 1, 1970 - August 31, 1971

Teachers - 71

Students (college) - 65

Instructors (college) - 4

Volunteers - 20

Other Professionals - 5

September 1, 1971 - August 31, 1972

From the field of the visually handicapped, 243 professional workers, from around the world were "toured", consulted with, etc. by IMRC staff members. Among these guests were some from as far away as Taiwan. Staff time given to this effort amounted to more than 225 hours, during working hours. These do not account for additional time spent over lunch, dinner, to and from airport, even overnight hosting.

September 1, 1972 - August 31, 1973

During this year, a total of 343 professional guests were served by the IMRC staff, but with only 126 hours involved. This was largely because several large groups were numbered. The Kentucky Council for Exceptional Children sent a group of 47, the National Braille Association had 20 members tour, Lions Club sent District Governors, and 30 Japanese teachers and administrators were hosted. However, individuals such as one staff member from the newly planned National Media Center, one administrator from Australia, and one teacher from the Republic of South Africa also were among our guests.

September 1, 1973 - November 30, 1974

Among those signing the guest register were administrators concerned with the kinds of services made available to the blind of the United States. Australia, Egypt, Japan, and Spain were represented by individuals who wished to have detailed information and individual conferences with the special staff members best qualified to answer special questions. The Kentucky Council for Exceptional Children again sent a group on tour -- this time the number more than doubled from the previous year's number.

CHAPTER THREE

LENDING SERVICES:
Materials for Prescriptive Teaching and Non-Prescriptive Aids for Utilization of Low Vision

The visually handicapped children of the U.S. comprise a small population and the programs serving them are as diverse in administrative policy and budgetary support as they are scattered geographically. Formerly, little concern was given to the use of low or residual vision. Since 1970, however, there has been an increasing interest in evaluating visual efficiency and in sequencing prescriptive teaching for improvement of visual efficiency. Material suitable for such teaching is not available to teachers generally for one or more of the following reasons:

1) Materials in good supply are not to be found in the average community.

2) Teachers do not have the time to search for materials nor the prior knowledge to make an evaluation as to their usefulness.

3) School budgeting usually does not allow for the purchase of such materials unless they can be firmly justified.

Therefore, teachers need to have a variety of materials in hand long enough to determine which ones are best suited for the prescriptive teaching indicated. The same problem exists in relation to non-prescriptive lenses or reading aids. Distributors do not keep in stock the wide variety needed to determine empirically if an aid can benefit a low visioned child. The Instructional Materials Reference Center, in its role of national center for vision, has been meeting these needs by making available both non-prescriptive lenses and materials for utilization of low vision training.

Since APH is a non-profit agency chartered only to produce and distribute materials required for educating the blind, but not available commercially, the American Printing House for the Blind was not able to support the purchase of materials for this lending service being extended by the IMRC. Therefore, additional outside sources of support were imperative.

The IMRC's two principal objectives and the ways of achieving them were:

1) To support teachers in their effort to improve utilization of low vision among visually handicapped children.

    (a) By providing an array of commercially available materials suitable for such training.

   (b) By keeping the inventory of such materials up-dated and rejuvenated.

2) To support teachers in their efforts to discover the usefulness of non-prescriptive lenses for certain low visioned children.

   (a) By providing an array of such devices on loan for a period of time according to their particular needs (number of children, number of teachers, kind of program).
   (b) By providing a list of sources for devices needed by the children involved.

Since April of 1970, when the first low vision material was purchased and made available, the inventory has been tripled through up-dating. With more than 200 items, some duplicates, more than seventy institutes and school systems have been served. The inventory of non-prescriptive aids numbers more than 225 items. From it, ninety-nine institutes and school systems have been served. There is always a waiting list for both services. Requests are repeated and extended many times which speaks for the benefits felt by those who have taken advantage of these services.

The places and numbers, where provided to the IMRC, are shown in the table which follows. The type program is coded for brevity. The materials are given as: 1) Lists which were annotated and/or arranged according to an outline which accompanied a guide for use in prescriptive teaching or more efficient use of low vision; 2) Low Vision Aids which were the Non-Prescriptive lenses for sub-normal vision; and, 3) ULV Commercial Materials which were for use in prescriptive teaching.

DATES: Sent-Returned	ORGANIZATION AND LOCATION	PURPOSE	ITEMS SENT	NUMBER SERVED	
				Adults	Students
Mar., 1970	University of Texas Austin, Texas	TI	ULV & LISTS	25	--
Apr., 1970	University of Texas Austin, Texas	TT	ULV & LISTS	--	--
	State Department of Education Denver, Colorado	TI	ULV & LISTS	60	--
	DeKalb County School System Atlanta, Georgia	IST	ULV & LISTS	30	--
May, 1970	Florida State University Tallahassee, Florida	TT	ULV & LISTS	40	--
	University of Arizona Tucson, Arizona	TT	ULV & LISTS	20	--
Jun., 1970	Peabody College Nashville, Tennessee	TI	ULV & LISTS	50	--
	Rehabilitation Center Palo Alto, California	TT	ULV & LISTS	36	--
	University of Texas Austin, Texas	TT	ULV & LISTS	50	--
	Portland State University Portland, Oregon	TI	ULV & LISTS	40	--
	San Francisco State College San Francisco, California	TI	ULV & LISTS	36	--
	State Department of Education Atlanta, Georgia	IST	ULV & LISTS	75	--
Jul., 1970	Illinois State University Normal, Illinois	TI	ULV & LISTS	20	--
Aug., 1970	State Department of Education Tallahassee, Florida	IST	ULV & LISTS	50	--
	University of Virginia Charlottesville, Virginia	TI	ULV & LISTS	65	--
	Virginia School f/t Deaf & the Blind Staunton, Virginia	IST	ULV & LISTS	50	--
	Governor Morehead School Raleigh, North Carolina	IST	ULV & LISTS	25	--

DATES: Sent-Returned	ORGANIZATION AND LOCATION	PURPOSE	ITEMS SENT	NUMBER SERVED	
				Adults	Students
Aug., 1970	University of Pittsburgh Pittsburgh, Pennsylvania	TT	ULV & LISTS	65	--
	Columbia University New York, New York	TT	ULV & LISTS	50	--
Oct., 1970	Boston College Boston, Massachusetts	TT	ULV & LISTS	30	--
	Florida State University Tallahassee, Florida	TT	ULV & LISTS	40	--
	Georgia Academy for the Blind Macon, Georgia	IST	ULV & LISTS	35	--
	Illinois Braille & Sight Saving School Jacksonville, Illinois	IST	ULV & LISTS	50	--
	Illinois Braille & Sight Saving School Jacksonville, Illinois	C&D	ULV & LISTS	--	--
	Northern Illinois University DeKalb, Illinois	TT	ULV & LISTS	35	--
Nov., 1970	Winter Haven Public Schools Winter Haven, Florida	PSP	ULV & LISTS	--	--
Feb., 1971	Scottsdale School District Scottsdale, Arizona	IST	ULV & LISTS	20	--
Sep., 1971	School Board of Pinellas County Florida	IP	Aids	4	35
	Towson Elementary School Baltimore, Maryland	PSP(IP)	Aids	--	--
Oct., 1971	Capitol Heights Center Capitol Heights, Maryland	PSP	Aids	--	15
	University of Arizona Tucson, Arizona	TT	Aids & ULV	--	--
	Pima County Governmental Center Tucson, Arizona	IP	Aids & ULV	1	"Several"

DATES: Sent-Returned	ORGANIZATION AND LOCATION	PURPOSE	ITEMS SENT	NUMBER SERVED Adults	 Students
Nov., 1971	Lancaster-Lebanon Intermediate Unit 13 Lancaster, Pennsylvania	PSP	Aids	2	50
	Rome City Schools Rome, Georgia	PSP	Aids	1	12
	Cochran School Louisville, Kentucky	PSP	Aids & ULV	1	12
Dec., 1971	University of Arizona Tucson, Arizona	TT	Aids & ULV	--	--
	Upjohn-Parkwood School Kalamazoo, Michigan	PSP	Aids	1	3
	Program for Visually Impaired St. Paul, Minnesota	IST	Aids & ULV	5	18
	Atlanta Public Schools Atlanta, Georgia	PSP	Aids & ULV	21	230
Jan., 1972	Fort Knox Nursery School Fort Knox, Kentucky	PSP	ULV & LISTS	1	2
	Schiel School Cincinnati, Ohio	PSP	Aids & ULV	--	--
Feb., 1972	Dougherty County Schools Albany, Georgia	PSP	Aids	--	--
	Illinois IMC State Teachers Chicago, Illinois	IST	Aids	220	--
	Dade County Spec. Education Programs Miami, Florida	IST	Aids & ULV	15	80
	Foundation for Blind Children Scottsdale, Arizona	TT	Aids & ULV	--	--
Mar., 1972	Stanislaus County Department of Educ. Modesto, California	IST	Aids	--	--
May, 1972	Buena Vista School Walnut Creek, California	RSP	Aids	--	--

DATES: Sent-Returned	ORGANIZATION AND LOCATION	PURPOSE	ITEMS SENT	NUMBER SERVED	
				Adults	Students
May, 1972	Unified School District Monterey Peninsula, California	RSP	Aids	--	--
	DuPont Manual High School Louisville, Kentucky	PSP	Aids	--	--
	Social Workers Louisville, Kentucky	TI	Aids	--	--
	State Department of Education Boston, Massachusetts	IST	Aids	--	--
	Orange Glen High Escondido, California	PSP	Aids	--	--
	Neff High School LaMirada, California	PSP	Aids & ULV	--	--
Jun., 1972	California State University San Francisco, California	TI	Aids	--	--
Jul., 1972	University of Texas Austin, Texas	TT	Aids & ULV	--	--
	Oklahoma School for the Blind Muskogee, Oklahoma	RSP	Aids	--	--
	Louisiana School for the Blind Baton Rouge, Louisiana	RSP	Aids	--	25
Aug., 1972	Michigan School for the Blind Lansing, Michigan	IST	Aids & ULV	--	100
	Bureau of Human Relations Biddeford, Maine	IP	Aids & ULV	--	--
Sep., 1972	County Schools San Bernardino, California	PSP	Aids & ULV	--	--
	Public Schools Pittsfield, Massachusetts	PSP	Aids & ULV	--	--
	Services for the Visually Handicapped Cheyenne, Wyoming	C&D	Aids & ULV	--	--
	Boston College (campus school) Chestnut Hill, Massachusetts	TT	Aids & ULV	--	--

DATES: Sent-Returned	ORGANIZATION AND LOCATION	PURPOSE	ITEMS SENT	NUMBER SERVED	
				Adults	Students
Sep., 1972	Schiel School Cincinnati, Ohio	PSP	Aids & ULV	--	--
Oct., 1972	State Department of Education Concord, New Hampshire	IST	Aids	--	--
	Brooks School Medford, Massachusetts	PSP	Aids & ULV	--	--
	University of Texas Austin, Texas	TT	Aids	1	--
Nov., 1972	University of Arizona Tucson, Arizona	TI	Aids & ULV	--	--
	Public Schools Pittsfield, Massachusetts	PSP	Aids	--	--
	Lake Marie School Whittier, California	PSP	Aids	--	--
	Human Relations Services Caribou, Maine	IP	Aids & ULV	1	10
	Santa Monica High School Santa Monica, California	PSP	Aids & ULV	1	--
Dec., 1972	Human Relations Services Caribou, Maine	PSP	Aids & ULV	1	6
Jan., 1973	Board of Cooperative Services Patchogue, New York	TI	Aids	10	63
	Boston College (campus school) Chestnut Hill, Massachusetts	TT	Aids & ULV	1	12
	Blind Children's Resource Center Portland, Maine	IP	Aids & ULV	1	25
Mar., 1973	Mississippi School for the Blind Jackson, Mississippi	RSP	Aids & ULV	--	--
	Leontime Lincoln School Fall River, Massachusetts	RSP	Aids & ULV	1	--
	Blind Children's Resource Center Portland, Maine	IP	Aids & ULV	1	25

DATES: Sent-Returned	ORGANIZATION AND LOCATION	PURPOSE	ITEMS SENT	NUMBER SERVED	
				Adults	Students
Jul., 1973	Participation House Markham, Ontario, Canada	RSP	ULV & LISTS	--	--
Aug., 1973	City Schools Knoxville, Tennessee	PSP	Aids	--	--
	State School for the Blind Jackson, Mississippi	RSP	Aids	--	--
	Bulloch County Dept. of Education Statesboro, Georgia	PSP	Aids	--	--
Sep., 1973	School for the Blind Lansing, Michigan	RSP	Aids & ULV	--	--
Oct., 1973	Robert Shaw Center Scottsdale, Georgia	TI	Aids	--	--
Nov., 1973	Wetzel County Schools Martinsville, W. Virginia	PSP	Aids	--	--
	School for the Blind Little Rock, Arkansas	RSP	Aids	--	--
Dec., 1973	Monterey County Office of Education Salinas, California	C&D	Aids	--	--
	Public Schools Owensboro, Kentucky	PSP	Aids	--	--
	Iowa Braille & Sight Saving School Vinton, Iowa	IST	Aids & ULV	--	--
	University of Southern Mississippi Hattiesburg, Mississippi	TT	Aids & ULV	--	--
	Ottawa Area Intermediate School District Grand Haven, Michigan	RSP	Aids & ULV	--	--
Jan., 1974	Intermediate School District Mt. Clemens, Michigan	PSP	Aids & ULV	--	--
Mar., 1974	Independent School District Boise, Idaho	PSP	Aids & ULV	--	--

DATES: Sent-Returned	ORGANIZATION AND LOCATION	PURPOSE	ITEMS SENT	NUMBER SERVED	
				Adults	Students
Mar., 1974	Program for Exceptional Children Athens, Georgia	RSP	Aids & ULV	--	--
	Highline Public Schools Seattle, Washington	PSP	Aids & ULV	--	--
Apr., 1974	Reading Conference New Orleans, Louisiana	C&D	Aids & ULV	--	--
	Mesa College San Diego, California	TT	Aids & ULV	--	--
May, 1974	Southwestern Union College Keene, Texas	TT	Aids & ULV	--	--
	Fishweir School #20 Jacksonville, Florida	TT	Aids & ULV	--	--
Jul., 1974	University of Northern Colorado Greeley, Colorado	TT	Aids & ULV	--	--
	Ohio State University Columbus, Ohio	TT	Aids & ULV	--	--
Aug., 1974	Georgia Academy Macon, Georgia	IST	Aids & ULV	50	--
Sep., 1974	Division of Instruction Lexington, Kentucky	TI	Aids & ULV	--	20
Oct., 1974	Coweta County Schools Newman, Georgia	PSP	Aids & ULV	--	--
	Washington School for the Blind Vancouver, Washington	IST	Aids & ULV	--	--
	Presbyterian Seminary Louisville, Kentucky	TI	Aids	--	--
	Public Schools Columbus, Ohio	PSP	Aids & ULV	--	--
	Oasis Elementary School Austin, Texas	PSP	Aids & ULV	--	--

DATES: Sent-Returned	ORGANIZATION AND LOCATION	PURPOSE	ITEMS SENT	NUMBER SERVED	
				Adults	Students
Oct., 1974	Knox County Schools Knoxville, Tennessee	IST	Aids	--	--
	Kentucky Industries & Rehab. Center Louisville, Kentucky	IST	Aids	--	--
	Governor Morehead School for V/H Raleigh, North Carolina	IST	Aids	--	--

C&D - Conference & Display
IST - In-Service Training
PSP - Public School Program
IP - Itinerant Program
RSP - Residential School Program
TI - Training Institute
TT - Teacher Training

The value of the above service has been reflected in two major ways, we feel:

(1) The sustained interest and ongoing requests for service which is shown in the above table.

(2) The voluntary feed-back which has come from many who made use of the service. A few of the comments received and not used previously are quoted below. They give some concept of the spread, both geographically and time-wise.

"The first type appealed to children with wide reading interests and strong reading skills. They were able to move this magnifier across the page at a distance which permitted normal reading posture and still have a large reading span. The second type was found to be useful by children who needed to see short direction sentences or specific examples in small print, such as in their spelling books or in their arithmetic books.

The children were not ready to accept the clamp on jewelers loupes. Instead, they seem to want the aid that is the least conspicuous or that can be laid down and is not considered a part of the personal appearances."

Nov. 9, 1971 - Baltimore, MD

"The kit has helped us select some types of magnifiers that will be of general use to our students. I feel that the loan kit is valuable in that it allows an evaluation of the magnifiers without the pressure to purchase them."

Feb. 1, 1972 - Kalamazoo, MI

"Thanks so much for rounding up the material for the Sight Utilization Workshop. They are great. We have found the IMRC publications that you have been putting together lately to be most helpful in our ordering of material. I am certain they will be new to most people and most helpful and welcomed by them."

May 25, 1972 - Capitol Heights, MD

"Discovering a good magnifier is like finding a friend who is willing to read little things for you several times a day."

Sept. 20, 1972 - Rome, GA

"It was a great opportunity for the students to be able to try the many devices under various circumstances." We have ordered some of the magnifiers for our resource rooms."

March 13, 1973 - Whittier, CA

"The magnifiers were helpful to my students, particularly the illuminated coddington magnifiers which several of the children found quite helpful, particularly for examining small objects, as in science class. They also found the Ezy Rede helpful for reading.

I am very grateful for the use of the instructional materials. I used them extensively in my pre-school program. I do apologize for the wear on some of the materials and will pay for any damage if necessary.

We have a limited budget and I know all my youngsters benefited from the use of these materials. I also now have a good idea of which of these materials I wish to order from my own funds."

July 23, 1973 - Biddeford, ME

"Some of the students have been stimulated into buying magnifiers of their own. The smaller magnifiers were consistently preferred over the larger ones, despite the fact that the rectangular reading glass covers a much larger reading surface. Repeatedly, the reason given was, 'the little one fits in my pocket', or 'I can use the little one without hassling the other kids'."

Feb. 27, 1974 - Patchogue, NY

"Thank you so much for the two copies of the list of materials available on loan. It's beautiful!

I would like to verify my impression that teachers may borrow directly without having to go through 'channels'.

Again let me thank you for your tremendous contribution to our successful Workshop in March and for your continuing cooperation and interest."

June 3, 1974 - Macon, GA

"The workshop at Missouri went well. They were very interested in the various types of magnification available and spent time looking them over. The staff of our school was also interested. I displayed them here, but more rewarding was the interest which my Vision Training students as well as my regular large print students showed in experimenting with the various types which we do not have here. I have made plans to order some. By having this good variety, the students were able to realize how much they needed and what type could be most helpful."

Oct. 9, 1974 - Jacksonville, IL

Copies of the three lists developed in conjunction with this service and mentioned above are included here. The first effort, developed early in 1970, was entitled "Utilization of Low Vision Bibliography and Materials List" and became a part of the Teachers Guide in the APH's Materials on Utilization of Low Vision. The alphabetically arranged annotated list presents items held through March 1974. "Non-Prescriptive Low Vision Aids" attempts to give basic information on items held through 1973. Other items in both areas have been added to the inventory since the production of each of the lists.

The American Printing House for the Blind in its original proposal was to underwrite the activities of the Instructional Materials Center for the Visually Handicapped, if and when Federal funding should not be available. APH plans to do so unless or until such time as a change of structure of service is agreed upon. Meanwhile, materials acquired under this section will be abstracted if funds are supplied. This would be used as input for whatever plan is maintained.

CHAPTER FOUR

EDUCATIONAL MATERIALS DEVELOPMENT

During the course of the project, educational materials development for the visually handicapped was conducted in a variety of areas. These included the areas of science, mathematics, social studies, braille reading, sensorimotor readiness, multihandicapped, low vision, educational measurement, and others. Individual projects in each of these areas will be described in subsequent chapters. The purpose of this chapter is to provide a general description of the procedures followed in educational materials development. Steps involved in development included needs identification, task definition, materials development, and materials evaluation.

Needs Identification

Materials needs were identified through literature surveys, consumer panels, textbook analyses, and consumer requests.

Review of literature resulted in identification of areas of long standing deficits in learning by visually impaired children. Examples of areas of broad needs include those such as braille reading, mathematics, and science. More specific identification of needs in these areas could be made through study of the research literature related to each. For example, studies of academic attainment in arithmetic computation and studies in braille word perception pinpointed needs in these areas. Needs were more specifically identified through organization of consumer panels, through textbook analysis, and through specific consumer requests.

Consumer panels for specific areas of needs were composed of small groups of teachers and others. Members of these panels were selected on a nationwide basis from persons identified as having an immediate interest in use of the materials and characterized in having specific training and long experience in education of the visually handicapped. These groups were brought to APH periodically for meetings of 2 and 3 days. The purpose of these meetings was to identify materials needs within a single curricular area such as science, specify these needs as much as possible, and then set priorities for their solution. Members of these consumer panels often participated in subsequent materials development as developers or reviewers.

Textbook analysis also helped pinpoint materials needs within specific curricular areas and grade levels. Analysis of several textbook series for a given subject within defined grade levels could result in identification of critical illustrative materials to which visually impaired students had no access, identification of operations required by the texts for which they lacked means to participate, and identification of specific concepts which were difficult to attain because of lack of adequate materials. Frequency counts of these across text series and grades help set priorities for development.

Requests by members of consumers for specific kinds of materials served as a stimulus for materials development. In some cases such requests are made informally through interpersonal contacts or through participation in professional or other meetings. Mail surveys provided a more formal means of determining consumer interest in specific materials. In both these cases frequency of requests were used to determine priorities for materials development.

Task Definition

Once a specific materials need was identified, responsibility for its fulfillment was assigned to a project leader. His first efforts concerned defining the task of filling the need. It was always possible that commercial materials already existed that, if identified, could directly fill the need or, if not, could do so with some modification. Consequently, a first step in task definition required a search of commercial catalogues. Possible materials were then obtained and examined. At the same time, literature was reviewed and informal inquiries made to see if there were teacher developed materials which might directly or with modification fill the need. When available, these too were acquired and analyzed. If commercial materials were already available, no further development effort was made. However, if commercial materials were found that must be adapted and evaluated, or if teacher materials were found that must be adapted and/or evaluated, or if no materials were found; a formal development effort was organized. Tasks to be attempted were reviewed annually by the APH Research Committee composed of heads of residential schools for the blind and representatives of state departments of education.

Materials Development

This phase consisted of planning and specification, review and revision, development of hardware and software, review and revision, and pilot test and revision. Once the task was defined, a plan was drawn up to attempt the task and detailed specifications for the materials written. This plan and sometimes the specifications were in later years parts of the IMRC annual proposal. Once the plan and specifications were written, they were subject to review by an internal APH committee which was permanently formed for the duration of the project. Upon review, necessary revisions in the plan or materials specifications were made and development of the materials initiated. Specifications for the hardware were given to the IMRC educational aids technician who developed the necessary models. Concurrently, the project staff undertook development of the software designed for use by students and/or teachers. Both were reviewed as needed in light of the original specifications by the appropriate IMRC committee augmented by consultants from the editorial and production departments of APH. Input from these latter consultants assured that materials were designed in realistic ways for manufacture at reasonable cost. Additional consultants from the appropriate consumer panel often reviewed these materials during this stage of development. During this same period, as components of materials came into being, they were often pilot tested with small groups of children representing the target groups. Reviewing, pilot testing, and revision cycles were continued until the project staff and review committee agreed that a viable product, meeting the original specifications and suitable for outside evaluation, had been attained. Materials at this stage of development were also reviewed by the APH Research Committee mentioned previously.

Materials Evaluation

During the overall planning of a project and during actual development, plans for its evaluation and criteria for this purpose were being determined. Near the end of the development phase these plans were brought to final form, criteria specified, and instrumentation developed for evaluation. These were subject to specific review by the APH review committee often assisted by outside consultants in research design and analysis. Evaluation plans were revised as required by these reviews. Several levels of evaluation were employed, often in combination. These levels were expert review, operational validity tests, teacher review after using the materials, and empirical field trials.

In some cases materials appeared so simple that expert review of them appeared sufficient evaluation. In this case, evaluators were always chosen from among trained and experienced teachers of the visually handicapped or from among appropriately trained and experienced members of the visually handicapped group. Reviewers applied relevant criteria previously identified using standard forms. Utilized to a limited extent in the first years of the IMRC project, this method was subsequently largely abandoned or utilized primarily in the final stages of product formulation.

In many cases the items evaluated were tools either adapted from commercial materials or especially developed. In other cases, they were tactile analogues of visual materials in common use. In both cases, evaluation consisted of empirically testing their operational validity. Such validity determined whether the materials had sufficient tactile legibility and whether students could perform the manipulations and operations necessary to attain the objectives for which the materials were designed.

Evaluation also occurred through teacher review while using the materials with the target population. Such use might occur over an extended period of time. Prior to evaluating the materials, teachers were orientated or trained to use the materials and to use the evaluation system. During use and upon completion of use, teachers evaluated the materials applying criteria defined by the project staff and reported on standard forms. Limited child use data often were gathered during this type evaluation.

Empirical field trials generating child use data based on pre- and post-testing were conducted. Special criterion tests measuring the degree to which users attained the objectives of the materials were either constructed by project staff or selected from among available standardized measures. Teachers were trained in use of the materials before actually using them with students. Comparison of pre- and post-training scores revealed the extent to which use of the materials resulted in student attainment of the specific educational goal involved.

Following evaluation, the results were reviewed to determine subsequent actions. In some cases, further development and evaluation was required. In others, only minor modification or no modification seemed indicated. When evaluation of the materials was completed to the satisfaction of the APH project staff and review committee, materials were submitted to the APH Educational Aids Committee for final review and approval for production. This committee was composed of heads of state schools for the blind and representatives of heads of state departments of education.

CHAPTER FIVE

DEVELOPMENT OF SCIENCE MATERIALS

Two parallel efforts to develop science materials were made. One was directed at the junior high and high school level and the other at the primary and elementary level. This chapter will include short reports of the tasks undertaken in each effort.

The program at the high school level was defined through efforts of a consumer panel which met in March 1970. Parallel to this, needs were further defined by two textbook analyses; one defining the problems of measurement encountered by students and the other defining seed plant illustrations required in science study. Three materials development tasks followed. These included the development of a science measurements kit, the development of models of simple machines, and the development of a series of biological models for plants and animals.

The program at the primary and elementary level was also outlined through the efforts of a consumer panel which met in October 1971. Needs were further defined through textbook analysis. This analysis defined the basic concepts presented in science textbooks in grades 1-3. Primary level materials developed under the program included the pull-apart cell, insect identification kit, dial thermometer instructional unit, primary level simple machines, experiments using the light probe, and the individualized science activities.

Task 1 Textbook analyses: Areas of deficit concepts in junior high science

Task Personnel Frank Franks

Purpose

The purpose of this inspection of science textbooks was to determine the concepts in life science, earth science, and physical science where greatest deficits in learning for blind students occur. More than 100 concept related activities were identified across the areas. These were inspected to determine those activities which involved measurement.

Procedure

Several sets of seventh, eighth, and ninth grade science textbooks, in inkprint and braille, were examined to identify the basic measurement concepts presented and the instruments used to illustrate them. These sets included appropriate volumes from the following series which have been transcribed into braille by the American Printing House for the Blind:

Science Today and Tomorrow Series. Caaig, *et al*. Ginn, 1958.

Harcourt, Brace and World Science Program. Brandwein, *et al*. Harcourt, Brace and World, Inc., 1964.

Today's Basic Science Series. Navarra and Zaffrononi. Harper and Row, 1965.

Van Nostrand Science Series. D. Van Nostrand Co., 1965, 1966.

The basic measurement related concepts were categorized into three areas: life science, earth science, and physical science. Specific activities, questions, and tasks were noted. A formal task or item analysis was not made in this preliminary inspection because of its exploratory nature and the subjective judgments involved in this inspection. Tentative priorities were established for further inspection or analysis of science textbooks.

Results

As a result of the inspection, the following tentative priorities were established:

1) Physical science appears to have the greatest deficits, largely because of the abstract nature of many of the experiments and activities illustrated.

2) Earth science and life science contain numerous illustrations and examples of concrete materials that can be explored tactually in original or model forms. Many of these materials, however, may require additional adaptation for use by blind students.

Further inspection in physical science revealed specific units of instruction where deficits occur. Some of the major units include:

1) Measurement
2) Mechanics
3) Properties of gases and liquids
4) Temperature
5) Weather
6) Heat
7) Electricity
8) Descriptive chemistry
9) Light
10) Sound

Measurement in science appeared to present the greatest single deficit in science instruction for blind students. Measurement appeared in or had implications for each of the above units. More than 100 activities, questions, and tasks were identified which appeared to involve operations difficult for blind students to perform without adaptation or specialized equipment. A great number of these involved measurement in some way.

Concepts in measurement in physical science which occurred more frequently and/or appeared to have significance for science instruction generally were:

1) Length
2) Area
3) Volume
4) Weight
5) Mass
6) Gravitational force
7) Density
8) Phase changes in matter

The inspection suggested that a number of basic measurement concepts could be illustrated using a small number of educational aids. The measurement devices which appeared most frequently and/or which were considered most important included:

1) Ruler, in inches and centimeters
2) Balances and weights
    a) Spring balance
    b) Pan or platform balance
    c) Triple beam balance
3) Graduates and various containers
4) Blocks of equal volume with different weights
5) Catch can and overflow can
6) Thermometer

Although this inspection was not a formalized textbook analysis, it provided basic information which eventually resulted in such materials as the APH Measurement in Science Kit and Simple Machines set. It has fostered additional textbook analysis and investigations of needs of blind students in science.

Task 2 Consumer panel meeting: Materials development in science for the visually handicapped (March 19-21, 1970)

Task Leader Frank Franks

Purpose

The purpose of the panel meeting was to examine areas in science where deficits in instructional materials are believed to exist, to identify specific aids necessary for teaching basic concepts in these areas, and to suggest priorities for development of relevant aids and materials.

Participants

Mr. A. H. Evancic, Western Pennsylvania School for Blind Children, Pittsburgh, Pennsylvania

Mrs. Isabella Holmes, Turner High School, Atlanta Public School Program, Atlanta, Georgia

Mr. Ross L. Huckins, California School for the Blind, Berkley, California

Mr. Ralph E. McCracken, Assistant Editor, Editorial Department, American Printing House for the Blind, Louisville, Kentucky

Mr. John Tortora, Lavelle School for the Blind, Bronx, New York

Mr. Jose R. Santana, New York Institute for the Education of the Blind, New York, New York

Results

As a result of the meeting the following priority list was made. High priority was given to the following areas and specific items:

A. Life Science
    1. Anatomical models
        a. Human torso
        b. Pull-apart cell
        c. Other anatomical models which should be adapted for visually handicapped students
    2. Three-dimensional models
        a. Animal set (invertebrates)
        b. Plant set
        c. Bacteria, planaria, etc.
B. Earth Science
    1. Weather kit
    2. Water chemistry kit
    3. Three-dimensional models in geology (Earth cross-section, etc.)
C. Physical Science
    1. Simple machines kit
    2. Chemistry materials

  a. Collection of experiments actually performed by blind students (AEVH?)
  b. Chemistry laboratory measurement equipment
  c. Atomic wall chart of periodic table
  d. Protective devices for partially seeing students

3. Electrical measurement materials
4. Sound kit
5. Model of an atom (pull-apart)

Individual Items identified

1. Light probe
2. Tactual tape
3. Davey lamp

The following recommendations were made in the meeting:

1. Existing instructional materials, kits and individual aids in science available from commercial distributors should be evaluated to determine their usefulness for blind and partially seeing students. The best representative of each kind of model should be considered for adaptation if it has instructional value for visually handicapped students.

2. The IMRC should alert central catalog users to materials available in science which have proven useful to visually handicapped students without adaptation. These materials should be evaluated by educators or specialists who have used the aids or have seen them in use in educational programs.

3. The IMRC should distribute information to the field to encourage the feasibility of visually handicapped students studying science.

4. Materials should be developed that get young visually handicapped students involved in science in the elementary grades. Simplified models with a minimum of detail should be made available.

5. The IMRC should become involved in the testing and production of the Science Curriculum Improvement Study materials in cooperation with the Lawrence Hall of Science (University of California). Many of these adaptations are to introduce the young visually handicapped student to basic science concepts.

6. Instructional procedures for using instruments and aids developed and/or adapted should be provided on an elementary level in braille and in large print.

7. Teachers' manuals for the above should be prepared where possible.

8. Appropriate IMRC personnel should be available to demonstrate at regional centers and meetings and at special conferences tangible apparatus and equipment developed for visually handicapped students. Emphasis would be on demonstration as opposed to display of materials.

9. Participants expressed concern and interest in education of visually handicapped students in public school and residential school settings, and recognize that visually handicapped students in public school programs integrated in sighted classes may have particular problems in science instruction which should be considered in the development, testing, and evaluation of instructional materials.

10. Investigations in other academic areas similar to this educational aids review meeting should be considered.

11. Reports of this meeting should be made available to members of the mathematics educational aids meeting.

12. Relevant information from this and other educational aids review meetings should be made available to educators in the field.

13. Participants in the science educational aids meeting agree to cooperate in so far as possible in the realization and implementation of the recommendations made herein.

A number of educational aids recommended for development in this meeting have been adapted/developed and are available through APH. Reports on development of these aids are included in this section.

Task 3 Textbook analysis: Seed plant illustrations in Biology Textbooks

Task personnel Marvin Murr

Purpose

The goal of this study was a compilation of those illustrations directly pertinent to seed plants which commonly appear in high school biology texts. It was designed primarily as a reference source for developers of tangible aids in biological science for the visually handicapped.

Procedure

If tangible aids are to be developed in accordance with the findings of a textbook analysis, it is important to employ the textbooks used by the target population. The American Printing House for the Blind currently published two biology textbooks. Each of these texts were analyzed in this study along with two additional representative textbooks. These latter books were included to increase the probability of obtaining the most commonly occurring, and hopefully, most important seed plant illustrations. The titles of the textbooks analyzed in this study were:

A. Modern Biology, Holt, Rinehart, and Winston, Inc., 1965 (APH, 1960 copyright, braille and large type)

B. Biological Science, Harcourt, Brace, and World, Inc., 1968 (APH, braille and large type)

C. Biology, Addison - Wesley Pub. Co., 1969

D. Exploring Biology, Harcourt, Brace, and World, Inc., 1966

Seed plants are characterized by their common utilization of seeds in reproduction and inclusion in one of two plant classes: Gymnospermae or Angiospermae. Illustrations employing seed plants range from those of a universal plant nature to those uniquely illustrating seed plant characteristics. Since seed plants, for themselves, are the object of this analysis, only illustrations of seed plant structure and/or function (life processes) have been included in this study.

Illustration criteria determine which nonverbal textbook presentations would be considered for inclusion in this study, as well as the form that an entry will take. Certain rules were followed in compiling them and only certain representations qualified as "illustrations." An illustration consisted of a picture, drawing, or diagram. In the latter case, it was required that at least 50% of the diagram be in picture or drawing form. Strictly verbal diagrams were not allowed.

The determination of an illustration was seldom a problem. Most every illustration encountered was accompanied by a combination chapter position figure number, such as 14 - 2 (2nd figure of chapter 14). Each illustration and its page number was recorded as a unit for future reference. Where two or more identified figures appeared on the same page, two or more entries were recorded.

Results

Each textbook analysis resulted in a long list of pertinent illustrations. The types of illustrations were too numerous and diverse to project a clear indication of their relative importance. Table 2 was developed to summarize these illustrations. It lists only those entries which commonly occurred in a number of the analysis tables. If an entry appeared in three or more texts, or in both of the texts produced by APH, then it was included in this list of important illustrations.

TABLE 1

Commonly Occurring Seed Plant Illustrations

ABCD*

1. Cross Section of a leaf (4 Anon.)
2. Lower leaf epidermis, stoma, guard cells (4 Anon.)
3. Longitudinal section of a flower (3 Anon., Apple)
4. Long section of a root tip showing growth zones (4 Anon.)
5. Structure of the female gametophyte - pollination to fertilization (4 Anon.) with a) illustration of pollen granule germination included (2 Anon.) or b) contained in a separate figure (Anon.) [D lacks "a" and "b"]
6. Phloem and xylem tissue [xylem only, in A] (4 Anon., 1 Ash-xylem only)
7. Cross section of a woody stem (6 Anon., Linden)
8. Cross section of a root (2 Buttercup, 2 Anon.)
9. Anatomy of a bean and corn seed [seed, reproduction] (5 Bean, 4 Corn)
10. Monocots (M) and dicots (D)

    Plants (ABD)

    M: 6 Corn (1 from #18), 2 Lily, Skunk Cabbage, Narcissus, Fan Palm, Wild Grass, Bamboo, Banana, Winter Wheat, Palm, Lady's Slipper
    D: 4 Buttercup, 2 Bean (1 from #18), Waratah, Bunchberry, Sycamore, Trollius, Black Walnut, White Oak, Poplar, Birch, Rose, Tobacco, Sunflower, Giant Saguaro

    Seeds (ABCD)

    M: 6 Corn (4 from #9), 2 Anon.
    D: 6 Bean (4 from #9), 2 Anon., Buttercup

    Leaves (BCD)

    M: 3 Anon., Corn
    D: 3 Anon., Bean

    Flowers (BCD; dicot only in D)

    M: 2 Anon., Easter Lily
    D: 2 Anon., Buttercup, Passion Flower

    Cross sections of stems (ABCD)

    M: 4 Corn, 2 Anon.
    D: 2 Anon., Bean, Buttercup, Basswood

11. Gymnosperms (4 Ginkgo, 4 Cycad)

TABLE 1 (Continued)

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12. Asexual reproduction [budding and grafting only, in A] (2 Strawberry, 2 Anon., Potato, Banana, Forsythia, Bryophyllum)
13. Route of water in transpiration process (4 Anon.) [transpiration and capillarity experiment only, in A (2 Anon.)]
14. Leaf venation (6 Anon., Corn, Bean - all from #10; 2 Anon., Oak, Sycamore, Redbud, Elm, Rose, Pea, Clover, Horse Chestnut, Honey Locust, Ginkgo, Lycopodium, Corn)

ABC

15. Long section of a stem tip showing growth zones [labeled parts only, in A] (3 Anon.)

ABD

16. Development of root hairs from root epidermal cells (3 Anon.)

ACD

17. Root hairs and absorption (3 Anon., Radish Seedling)
18. Germination of a seed into a seedling (4 Bean, Corn)
19. Geotropism experiment (3 Anon.)
20. Types of pollination (2 Anon., Pea, Corn, Clover)

AB

21. Principal root systems: fibrous (2 Grass) and taproot (2 Beet)

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*Textbook designation by letters are:
A - Modern Biology (APH)
B - Biological Science, An Inquiry into Life (APH)
C - Biology, Introduction to Life
D - Exploring Biology

Summary and Concluding Statements

Demands of materials developers for a list of about 6-8 important plant illustrations to be developed as part of a set of biological models led to a three-way classification of the entries in Table 1 according to their level of complexity. Illustrations primarily concerned with plant structure were determined to be elementary and to constitute a foundation for the understanding of illustrations demonstrating plant function and abstract qualities of plants. Seven illustrations of plant structures were finally recommended for materials developers, five of which were endorsed by their inclusion in a currently produced, raised line drawing biology manual for the visually impaired. The seven illustrations are:

1) Flower (Sagital section)
2) Leaf (Transverse section)
3) Lower Leaf Epidermis (Sagital section)
4) Root (Transverse section)
5) Root tip (Sagital section)
6) Seed (Sagital section)
7) Woody stem (Transverse section)

These illustrations recommended for modeling are now part of a set of nineteen plastic biological models which were subsequently developed and now are distributed by APH.

Task 4 Development of a science measurements kit for blind students

Project Personnel Frank Franks

Purpose

Blind students have difficulty in learning measurement concepts in science because of their inability to read standard measurement devices. This problem was identified in Task 1 of this chapter. A systematic effort was made to discover and evaluate science materials currently available for use by the sighted and to adapt these where possible for the instruction of blind students. New devices were to be developed when necessary. The preliminary examination suggested that a number of basic measurement concepts could be illustrated using a small number of devices.

The purpose of the study was to determine if blind students at the elementary and junior high level can successfully perform tasks in measurement which indicate their ability to read the tactile faces and raised surfaces on the measurement devices.

Procedure

Three devices, the spring balance, pan balance, and thermometer were adapted so that blind students could read them. These machines are available commercially from various distributors. A dial spring balance was adapted by adding raised lines to the face to indicate weight measurements. Different textures on the face were used to differentiate the gram scale from the ounce scale. A raised vertical line was added to the face of the pan balance to indicate the center of the face. A tactile ruler graduated in inches and centimeters with raised line indicators and a movable guide was developed. The other two instruments essential to performing the basic measurement operations were the overflow can and the catch can which required no special adaptations.

Where feasible, research findings were implemented in development of special tactile faces for the instruments (Morris & Nolan, 1963; Nolan & Morris, 1963, 1965). Efforts were made to adapt instruments according to the tactile needs of the blind student rather than simple translating visual symbols to tactile symbols. Adaptations were made as simple as possible.

Twenty tasks were selected for use in evaluating each student's ability to read the tactile faces and surfaces of the ruler, spring balance, pan balance, and thermometer.

Students used the ruler to measure the length of items in the kit, to convert from inches to centimeters, and to convert from centimeters to inches. They used the face of the spring balance to convert from ounces to grams and weighed the metal blocks included in the kit. Specific gravity specimens were weighed using the pan balance and the four weights were arranged from lowest to highest weight. Finally, students used the thermometer to note changes in temperature from freezing to boiling point.

A three-step procedure for evaluating suitability of the devices for blind students was followed:

1) Introduction. The use of each instrument and the construction of each tactile face were explained in group sessions. The operation of each instrument was explained and students were given opportunity to examine each one tactually.

2) Review. Each measurement instrument was reviewed in class. The examiner was present to clarify points and to answer questions from teachers and/or students. Instruments were again circulated and students were permitted to perform simple measuring and weighing exercises which involved reading the tactile faces.

3) Evaluation. The twenty tasks were performed by students in individual sessions, and answers were recorded on answer sheets.

The total time involved in accomplishing these three steps ranged from four sessions for small groups to six sessions for large groups. No time limits were set in performance of tasks since ability to perform was emphasized over time required to perform the tasks.

Materials

Following is a brief description of the four measurement devices adapted and/or developed. Pictures of the materials appear in a brochure included in Appendix B.

The ruler. The ruler was developed to teach the difference between the metric and English system and for general measurement operations. Teaching the difference between the metric and the English system is facilitated by originating the centimeter scale at the upper corner and the inch scale at the lower corner with measurements progressing from left to right. With this arrangement it is simple to illustrate that 2 1/2 centimeters are equal to one inch approximately. To assure accurate reading of notations, no dimension smaller than one-half centimeter nor smaller than one-quarter inch appears on the ruler.

The raised line indicators are approximately .025 inches in height. Braille notations occur at 2 centimeter intervals beginning with the second interval. Inch intervals are also labeled. The ruler is 1 1/2 inches wide, and one-fourth inch thick in the center tapering down to one-eighth inch at the reading edges. The back of the ruler is hollow to provide flexibility and to reduce weight.

The (dial) spring balance. The dial face for the spring balance consists of a complex radial display of raised lines and surfaces designating grams (in tens-of-grams) along the outer perimeter and ounces countersunk within an inner circle. The raised lines are approximately .040 inches high. Distance between lines is more than 6 millimeters.

To overcome possible confusion caused by the shift from grams indicated along the outer perimeter to ounces indicated on the inner dial, contrast of the two sets of units is emphasized by the use of textures. The outer dial consists of a smooth surface and the inner dial is a rough textured surface. The inner dial is countersunk approximately .050 inches to provide a distinctive tactile edge. This redundance was built in as an aid to perceptual performance because of the complexity and high noise level of the tactile face of the spring balance. Schiff and Isikow (1966) stated that as diagram difficulty increases additional redundancy appears to play a role in reducing errors. Redundancy involves encoding a message so that it contains more symbols or stimulus features than the minimum necessary to transmit the information contained in the message. The authors concluded that the best mode of presentation in diagrams when noise is high is the textured and raised format - the most redundant. Thus contrast and redundancy are emphasized in the adaptation of the face of the spring balance.

This spring balance is designed for weighing in grams although weighing in ounces can be accomplished. The balance is so designed that the index finger can be used to find measurements indicated by the needle usually in grams. Then the middle finger can be used as an anchor while the index finger moves from the gram scale across the tactile boundary to the ounce indicators on the textured inner dial. The ring finger can be employed, if necessary, for holding the original starting point as the index finger moves to the inner dial and the middle finger follows over the tactile edge between the two dials.

The pan balance. The face of the pan balance is less complex than that of the spring balance. An object of unknown weight is placed in the left tray and balanced with known weights in the right tray. The face of the pan balance consists of a smooth surface with a wide raised vertical line to mark its center. When the needle rests on the raised center line, the pans are in balance. If the needle is off center then weight must be added to or subtracted from the right hand tray to achieve balance.

The Fahrenheit (dial) thermometer. The face of the dial thermometer is 3 inches in diameter. Around the outer edge approximately one-fourth inch above the base is the tactual portion of the face. Temperature is indicated in 10 degree units by one-fourth inch lines that are approximately .040 inches high.

Both freezing point (32° F) and boiling point (212° F) are marked with a large braille dot .050 inches high. The interval from 70 to 80 degrees Fahrenheit is indicated by a rough textured surface raised to approximately .040 inches. Zero degrees Fahrenheit is indicated by a notched incision in the outer rim of the dial face.

The thermometer is designed to indicate temperatures ranging from below freezing to boiling point, with emphasis on indicating points at which phase changes in matter occur. Although the thermometer was not designed for general use, it can be used to perform a number of activities in measuring temperature. The textured 10 degree interval between 70 and 80 degrees enables students to measure temperatures of liquids at room temperature more easily and serves as a reference point between freezing and boiling points.

Subjects

Seventy subjects, 51 junior high and 19 elementary school students, grades four through nine, were used to field test the instruments. Distribution of students by grade is given in Table 1. All students were braille readers from residential schools for blind children.

Table 1

Grade Distribution of Students

	Grade	Number of students
Junior high	9	10
	8	23
	7	18
Elementary	6	13
	5	4
	4	2

Results

On the four devices, the percentage of successfully completed assigned measurement tasks ranged from 79 to 99. A breakdown of percentages for individual devices is presented in Table 2.

Table 2

Percent* of Measurement Tasks Successfully Completed

Tasks	Percent Correct
Ruler	79%
Spring balance	86%
Pan balance	80%
Thermometer	99%

*Percents rounded

Summary

The high level of performance achieved by students in the study indicates that both elementary and junior high students were able to read the tactile faces on the instruments in the performance of elementary measurement tasks.

Task 5 Development of simple machines for visually handicapped students

Project Personnel Annette Bettinger

Purpose

The initial review of science textbooks (Task 1) showed mechanics as the area second in importance to measurement where materials were needed for junior high level students. The subsequent meeting of the science consumer panel (Task 2) identified simple machine models as necessary materials to demonstrate mechanical principals to students at all levels. Consequently, development of this set of materials was undertaken. As defined through analysis of science textbooks, the models included the wheel and axle, screw, inclined plane, lever, and pulley as simple machines for separate study.

Procedure

The five junior high science textbooks were reviewed to determine the variety of mechanical principles taught and their frequency of occurrence. From this review, the list of machines named above necessary to demonstrate these principles was developed. From this review also was generated a set of specifications for each machine. An example of specifications for the wheel and axle appears in Table 1.

Table 1

Wheel and Axle

Aids to be used to develop the following

CONCEPTS:

1. To demonstrate a wheel and axle.
2. To provide opportunity for observing the effect that ball bearings have on friction.
3. To compare distances traveled when a weight is suspended from the axle to when the weight is suspended from the wheel.
4. To demonstrate the effect that the size of the wheel has on mechanical advantage.

DESCRIPTION:

axle, wooden discs and ball bearing discs, platform support with upright legs, grooved wheels with turn handles, a "spoke wheel", and tackle.

The model is an axle and interchangeable wheels supported by two uprights. It is designed with an opening between the uprights so that weights may be raised and lowered from the axle. The materials will be of strength to support at least 10 pounds.

Axle - One to be provided -

One end is to have a head for secure location and the other end is to have a slot to act as a receiving channel for wheels.

In line with the slot, a shallow hole about 3/16 inches in diameter is to be located about 15 1/2 centimeters from the head. Its location must be such that a finger will simultaneously touch it as well as the marker on the upright. (The purpose of the hole and the marker is to provide landmarks for the recognition of a complete rotation.)

The axle is to be 3 centimeters in diameter. Its length must span the 12 centimeter distance between the uprights, pass through the supporting holes, and provide a seating place for a wheel.

Wheels - Four to be provided -

Wheels are grooved to a depth of about 1/2 inch. The width of the groove is also 1/2 inch.

The hole in the center of the wheel will permit entrance of the axle. A stationary rod across the center of the hole is to slide into the slot.

The face of one side of the wheel has five landmarks. All are at the edge or near the edge. A turn handle, a notch (to secure tackle), and a braille number (to designate size of wheel) are in line with the stationary rod. Two markers (to designate distance) are perpendicular to the stationary rod. See diagram.

The braille number is actually the measurement of the diameter of the groove location.

The turn handle needs to be located so it will be in line with the groove bed.

Size of Wheels

Number	Diameter at groove bed location
1	5 centimeters
1	10 centimeters
1	15 centimeters
1	20 centimeters

"Spoke wheel" - One to be provided -

The purpose of a spoke wheel is to point up that a unit shaped differently can perform as a wheel.

A length of 10 centimeters is recommended as ease in handling.

Platform support with upright legs - One to be provided -

A base with two upright legs is to support the axle and the discs. The base is designed with an opening hole to permit passage of the weights. The base needs to be large enough to permit use of a vise without interfering with use of a machine.

Holes in the legs are to be designed so that the discs may be placed as well as displaced from them. The present model has two metal cups for this purpose.

On the leg (right as one faces the opening) will be a line marker. Its location will be centrally located just above the hole.

Discs - Four to be provided -

Discs are to be inserted into the holes of the legs for the purpose of receiving the axle. They are to be of two types.

a. plain (wooden?) discs (two)
   These are for the purpose of creating friction.
b. ball bearing discs (two)
   These are for the purpose of reducing friction.

Tackle - Two sections to be provided -

a. axle section - Tackle will have an open-close hook on one end and a loop on the other. The loop must be large enough so that the hook will pass through it.
b. wheel section - Tackle will have an open-close hook on one end and a means for holding the tackle in place in the wheel notch on the other end. (Present model is knotted.)

The lengths of the tackle should be such that the hooks will reach the floor when secured in place.

The axle section would have at least one full turn of tackle around the circumference.

The wheel section of tackle would originate from the greatest height of the wheel.

Some manipulation will need be done by the user because of the different heights of the weights and the different size wheels. Also the machine itself may be placed at different levels. (It seems that 'desk height' might serve as a guide for length of tackle.)

Commercial catalogues and simple machines materials available from such sources were surveyed to discover if suitable materials were already available. Materials reviewed were only partially suitable for use with visually handicapped students. All commercial materials required the use of sight for data collection and most required fine hand-eye coordination for actual physical manipulation of the components.

Since adequate materials were not available from commercial sources, special machines were designed to meet the specifications. Models of all machines were then constructed. These were reviewed by an APH committee to determine the degree to which they met the specifications and for their legibility and general usefulness to visually handicapped children.

Pilot Test. After minor revisions, the models were tested with 56 students in grades 2-12 at the New York State School for the Blind. Most of these tests focused on the ability of students to manipulate the machines. Questions explored included ease of assembly of parts, ease of opening and closing hooks, and ease of making the measurements and the readings required. Pilot testing led to redesign of the hooks used with all devices, variation in the weights of the tackle employed, and redesign of the pulleys to facilitate their tactual threading.

Field Test. Fifty-six students in grades 5-12 at the Maryland School for the Blind participated in the field test. Eight days were spent in presenting concepts, introducing the machines to the students, observing their abilities at manipulation, and testing their abilities to successfully perform operations using the machines.

Formal lesson plans were prepared to introduce the machines to the students and present the concepts involved. The project leader conducted all formal instruction. The science teacher, fifth grade teacher, and sixth grade teacher participated in the program. A preliminary meeting was held to review the lesson plans before actual instruction was begun.

Following familiarization and instruction in concepts, the students were observed to determine the extent to which they could identify the components of the apparatus and manipulate these as required. Items observed appear in Table 2 below.

Table 2

Identification and Manipulations Tasks

	Lever	
Can Identify	Can Assemble	Can Judge
stand and vertical support groove and notches for fulcrum slot for fulcrum at each end channel for slides slide holders and pointers measurement lines braille numbers	attach weights move slides to given location change fulcrum position locate fulcrum at either end	estimates distance between numbers reads scale on lever
	Inclined Plane	
the plane projecting edge raised sides pulley the support level grooves	wet plane at given level thread cord through pulley attach spring balance	measure height of plane
	Pulleys	
stand and vertical support horizontal bar hook collars wheel and groove axle frame tackle	attach fixed pulley thread fixed pulley attach weight to tackle thread movable pulley attach weight to pulley thread single block and tackle attach spring balance to tackle thread tandem block and tackle thread double block and tackle force tackle back into groove	count number of strands that hold movable pulley keeps tackle in line with groove measure vertical distance moved by resistance measure vertical distance moved by effort measure force with spring balance

	Wheel and Axle	
base and legs cups for holding inserts inserts axle wheels axle and wheel cords	inserts axle wheel locate wheel handle at bottom affix wheel holder attach axle cord attach wheel cord attach spring balance attach weights adjust cord for tautness	estimate 1 revolution of wheel estimate 1 revolution of axle measure vertical distance moved by resistance measure vertical distance moved by effort measure force with spring balance
	Cylinder Screw	
cylinder and groove hypotenuse on triangle	place triangle in groove twist triangle around cylinder attach holder	measure height of thread area measure pitch

Operational tasks to be completed by the student were developed for the lever, the inclined plane, the wheel and axle, nuts and bolt, the cylinder screw, and the jack screw. The experimenter and teachers worked individually with students to determine if they could accomplish each task. Students received no help during this work with the machines. Student responses were rated 3 if the student correctly performed the operation and gave a correct arithmetical answer, 2 if the student performed the operations correctly but gave an incorrect arithmetical answer, 1 if the student could only partially perform the operation, and 0 if he failed to perform the operation. The list of operational tasks appears in Table 3.

Table 3

List of Operational Tasks Required for Each Machine

Wheel and Axle

1. Use a measuring stick to measure the vertical distance moved by the resistance (R) when suspended from the axle (2 tasks).
2. Use a measuring stick to determine the vertical distance moved by R when suspended from the wheel.

Nuts and Bolts

1. Turn the nut one complete revolution.
2. Judge the relative size of spacing between two different settings of two nuts on a single bolt.

Cylinder Screw

1. Measure the thread area.
2. Measure distance between sections of thread.
3. Judge the relative size between two thread areas.
4. Judge the relative size between two pitches.

Jack Screw

1. Read the pitch scale on the weight.
2. Turn the bolt so that a required number of pitches will show on the pitch scale (2 tasks).

Inclined Plane

1. Read the spring balance while pulling R up the inclined plane (2 tasks).
2. Place the inclined plane at a level which will give a known effort (2 tasks).

Lever

1. Place the lever at a given fulcrum placement.
2. Given all data but weight, balance the lever by selecting the correct weight.
3. Given all data but distance, balance the lever by selecting the correct distance from the fulcrum.

Following the field test, the machine models were slightly modified to overcome the few problems encountered and produced. A brochure in Appendix B pictures and describes the final version of the materials.

Development of the Manual. Once production models were available, the lesson plans written to familiarize the students with the machines and to teach related concepts and the testing tasks were expanded into a manual to provide the teachers with guidelines to introduce and demonstrate the machines with students. The initial draft of the manual was twice reviewed by an APH committee and twice revised. It was subsequently reviewed in use with blind students by the science teacher at the Oak Hill School for the Blind, who made a final revision.

Results

The abilities checklist (Table 2) enabled the experimenters to rate each student in these areas for each machine. These areas included items on identification of parts of the machine, ability to assemble the machine, and judgments of various positions of the machine and its parts. The student received a score of 1 if he could independently identify or perform and a score of 0 if he could not. A small amount of help was offered if needed by the experimenter in each case. Tasks for which help was given were identified for each student.

Fifty percent of the students were able to accomplish all the identification and manipulation tasks correctly. An additional twenty-nine percent were able to perform independently except for one item. Another 7 percent needed help with two items. The remaining 14 percent needed help with three or more items.

Most help was required by grade 5 students, while 11 and 12 grade students required only slight help with pulleys. The greatest single problem was identifying the hypotenuse on the triangles on the cylinder screw. This appeared to be a vocabulary problem. The second greatest problem involved adjusting the cord on the wheel and axle for tautness.

With the exception of one machine, children were able to perform operations with a high level of success. One hundred percent performed all the lever operations and calculations correctly, 100% performed all the jack screw operations and calculations correctly, 94% performed all the wheel and axle operations and calculations correctly, 94% performed all the nuts and bolt operations and calculations correctly, and 91% performed all the cylinder screw operations and calculations correctly.

By contrast, only 14% performed all the inclined plane operations correctly. Seventy-six percent of the students were able to perform all operations correctly, but gave an incorrect arithmetical answer to at least one of the four tasks. Twenty-four percent of the students failed to successfully perform all the operations as well as not give correct arithmetical responses. Most students who fell in this latter group were in grades 5-8.

Most errors for the inclined plane arose from the task of reading a spring balance while pulling a weight up the inclined plane. This task did not receive sufficient attention during the instructional period. Subsequently, in writing the manual for the inclined plane, training in this phase of use of the apparatus was expanded. Try-out of these materials with the 12 high school students who participated in the manual review indicated that this problem was greatly diminished through increased training.

Summary

Models of five simple machines were developed and field tested. Students were able to use the models successfully. A teachers manual based on the field trial procedures was written and reviewed. All materials were subsequently produced and disseminated by APH.

Task 6 Biological models for blind students

Project Personnel Frank Franks and Marvin Murr

Purpose

One of the most pressing needs in the education of the visually handicapped is finding alternate methods of presenting material which is usually exhibited visually. The normally sighted student of biology typically relies upon a number of non-verbal learning aids to attain the curriculum objectives. Textbook pictures, diagrams, and illustrations, along with three-dimensional models, and laboratory specimens, constitute a major contributory to the learning process. However, these aids are chiefly visual and are of little or no value to the visually handicapped student. Alternate methods of presentation must be found if these students are to obtain the valuable, and perhaps unique, information which these aids impart.

The need for instructional materials in the biological sciences was emphasized by participants in the consumer panel on Science for visually handicapped (Task 2). Members identified the biological sciences as an area with a critical shortage of these educational materials. In particular, they cited the lack of satisfactory tactual models of representative species of the major plant and invertebrate animal phyla.

Biological models currently available include enlarged, commercially produced, three-dimensional wooden or plastic models and embossed representations which appear in braille textbooks. The three-dimensional models are typically designed for visual presentation, frequently lack adequate tactual legibility, and are usually quite expensive. Similarly, embossed diagrams are often illegible due to the inherent limitations of two-dimensional representations of three-dimensional objects and the addition of confusing indicator lines and dots. These indicator lines are easily confused with the outline of the model itself and often the result is a meaningless maze of raised lines and braille dots.

Merry and Merry (1933) reported a study exploring the ease with which blind children in kindergarten through grade 6 recognized simple two- and three-dimensional designs and pictures embossed in paper. They found that the recognition ability of these children was very limited, with 16% of the subjects failing to identify any of the pictures. Despite this finding, embossed diagrams and pictures continued to be produced (Heisler, 1959).

Mandola (1967) has pointed out that one of the most common errors made in developing tactual aids is assuming that what is seen and understood by the sighted will be similarly understood by the visually handicapped through graphic aids. Adequate tactual aids must not only replace visual symbols with tactual symbols, but in so doing must meet the criteria necessary for accurate tactual perception (Franks, 1971). Recently, a series of three-dimensional maps (landforms) which tactually and chromatically illustrate basic geographical concepts (Franks & Baird, 1971a) were developed at APH. These models were molded of high impact styrene by a vacuum form process and have proven to be very effective teaching aids (Franks & Baird, 1971b).

Vacuum formed plastic is a low-cost medium which appears to be a significant improvement over embossed diagrams. It is quite tractable and lends itself well to the representations of depth, contour, shape, and size. Component recognition can be increased by the addition of tactual and chromatic coding. The science consumer panel recognized the inherent qualities of vacuum formed plastic and recommended that it be used in the construction of more adequate biological models for visually handicapped students.

The purpose of the following study was to apply this technique to the biological sciences in an effort to provide materials which afford greater tactual legibility than existing embossed diagrams and three-dimensional aids. Specifically, a set of 19 vacuum formed biological models (schematics) were developed and tested for tactual legibility. (See Table 1)

Procedure

Pilot testing revealed that it would be difficult to test all nineteen biological models with one subject in a single test session. It was decided, therefore, to divide the models into sets of nine and ten models each. The composition of these final testing sets represented the experimenters' best effort to segregate the models with comparable physical configurations and pilot test times into two groups of relatively equivalent content and difficulty.

The two sets of biological models were tested by assigning them to successive subjects of a grade level in a counterbalanced order (ABBA). The order of model presentation was randomly determined prior to field test administration and cue cards were shuffled after presentation of each model. The subjects' task in this study was to examine cue cards displaying individual model parts and then locating these parts on the models by tactual recognition.

The testing session was conducted with the experimenter reading to the subject (who was blindfolded if he had useful vision) a set of standard instructions describing the purpose of the study, the procedure to be followed, and the three kinds of cue cards that would be used. The first model was then presented to the subject for a preliminary inspection. This familiarization period with the model continued until the subject was "ready to begin" or one minute had elapsed. Subsequently, the experimenter presented the first cue card to the subject and read the appropriate verbal direction from the testing sheet. The subject was allowed as much time as he desired to identify the part on the model corresponding to the part displayed on the cue card. After the subject had located what he believed was the same model part, he touched it with his finger and said, "Here." The experimenter recorded the accuracy of his response. As soon as the subject had made a response to one cue card, another was presented until all the cards for a particular model were exhausted. A similar procedure was followed in the presentation of the eight or nine remaining models in the group. Before the second and third model presentations, the explanation of the three kinds of cue cards was reread to the subject, but thereafter, only upon his request.

Materials

The consumer panel suggested that models be developed to illustrate the most representative species of each invertebrate animal and plant phylum. According to the *Modern Classification of Organisms* (Otto & Towle, 1965), there are 18 such animal phyla and only 2 plant phyla. However, a visual inspection of four series of junior and senior high school biology textbooks, two series of science books for the elementary grades, and several college zoology texts revealed that only eight of the eighteen invertebrate phyla received sufficient illustrative and textual treatment to warrant development in consideration of their importance. Similarly, an analyses of biology texts (Task 3) showed that a single class (flowering plants) within the plant kingdom was afforded almost as much consideration as all the other plant classes combined. Development of models, therefore, was restricted to the most representative species of the major invertebrate phyla and to the important illustrations of flowering plants.

The specific invertebrate species chosen to represent each phyla were ones which had been identified as representative of their respective phyla and enjoyed the widest popularity in science courses at all grade levels. Flowering plant illustrations chosen for modeling depicted plant *structures* and appeared commonly in a majority of the biology texts analyzed.

Table 1 lists the models that were developed. It was sometimes necessary to construct more than one model of each animal illustration to illustrate the essential structures and still maintain adequate tactual legibility.

Table 1

Zoological and Botanical Illustrations Selected for Modeling

Model	View
	Animal
Paramecium	Sagital Section
Sponge	Sagital Section
Hydra	Sagital Section
Planarian (3)	External Views (dorsal and ventral) Sagital Sections (nervous system, digestive system) Transverse Section
Clam	Sagital Section
Earthworm (2)	Sagital Section Transverse Section
Starfish	Sagital Section
Grasshopper (2)	Sagital Sections (respiratory system, digestive system)

Plant

Leaf	Transverse Section
Root	Transverse Section
Woody Stem	Transverse Section
Root Tip	Sagital Section
Flower	Sagital Section
Seed	Sagital Section
Lower Leaf Epidermis	Sagital Section

The decision of which structures to include in each model was determined by a visual inspection of its respective illustration in textbooks. Important structures are most always labeled and directly referenced in the text. If a plant structure was so indicated in both of the biology texts published by APH or in a majority of the four textbooks analyzed (Task 3), then the structure was depicted in the models. Animal structures included were determined by their common appearance in comparable textbook illustrations. As many important structures as could be legibly presented in a model were included.

The models were constructed with an emphasis on simplicity and offered redundant features where complexity was unavoidable. Texture, size, shape, and relief were used to maximize legibility. Structures were designed to be as realistic as possible yet simple enough to permit efficient tactual identification. An attempt was made to keep model size as small as possible to permit tactual integration but large enough to maintain legibility, relative proportion, and position of parts. Tactual coding and legibility of the models were determined on the basis of findings from studies in tactual research (Nolan and Morris, 1971; Wiedel and Groves, 1969) where possible.

The models were molded of 15 mil high impact styrene by a vacuum form process. The overall model size was 9" x 11 1/2" and maximum relief was approximately 1 inch. Many of the areal symbols used on the models had been previously found to be highly discriminable by Morris and Nolan (1961).

The models were painted with acrylic lacquer. Chromatic coding was employed to maximize the color and luminance contrasts previously found effective on other aids for low-vision students (Franks & Baird, 1971a, b). A brochure describing the models as finally produced can be found in Appendix B.

For testing purposes, nineteen sets of 3 1/2" x 3 1/2" plastic cue cards were developed to display individual parts of each model. Some of the cards contained intact model parts as they appeared on the models. However, many model parts extended over large portions of the model and could not be entirely exhibited on the cue cards. In these cases, samples of the areal symbol (1 3/8" squares) or linear symbol (small sections) composing the model part was displayed on the cue card.

A number of short verbal directions were developed to accompany the presentation of the different types of cue cards. The first sentence of each direction was the same: "Here is a cue card." The second (and usually last) sentence directed the subject to locate a point (Find this structure on the model.), areal (Show me a texture like this on the model.), or linear (Show me a part of the model which is like the sample on the cue card.) symbol on the model similar to the one displayed on the cue card.

Subjects

A total of 24 male and 18 female braille readers enrolled in summer school programs at the Ohio State School for the Blind, Missouri School for the Blind, and the New York State School for the Blind participated in this study. All students were enrolled in academic programs during the previous school year in grades 7-12. Thirteen of these students attended public schools during the regular school year.

Results One hundred and two parts on nineteen models were evaluated for their tactual discriminability. The mean percent of correct subject responses was 95%. A criterion of 85% correct responses per model part was set prior to testing. Ninety-four of the tested parts exceeded the criterion, while the remaining eight parts were correctly located by 62% to 81% of the subjects. The eight failing symbols were parts of five of the models.

The high level of student performance attests to the overall high discriminable quality of the models. The eight model parts which failed to meet the criterion were examined in their total context to determine the cause of their failure. Each part was studied with respect to its tactual quality, proximity and similarity to other component parts, key card and test question employed, and prior general instruction. The results of this informal analysis were used to make modifications to the models. Wherever a modification to a model part appeared insufficient to correct a deficiency, it was entirely replaced by another model part or symbol shown to be discriminable in this study.

Modifications were made to three of the five defective models by replacing one illegible symbol with another proven discriminable in this study. However, the changes made to the two remaining models included both multiple substitution of discriminable for indiscriminable symbols, and the modification of two "opening" symbols per model. "Opening" symbols constituted just 5% of all parts tested, but accounted for approximately 40% of the model parts below criterion. The improportion of these symbols in the failure group raised serious doubts about the tactual quality of any new "opening" symbol used to replace an inadequate one. With these considerations in mind, an APH project review committee recommended the retesting of these latter two models to insure their tactual adequacy.

Twenty-two braille readers enrolled in academic classes at the Kentucky School for the Blind from grades nine through twelve were used to retest the modified models. The procedure used to test the models was identical to the testing format followed in the main study. Appropriate additions and deletions were made to the sets of cue cards in accord with modifications made to the models.

Every symbol which failed its first test of tactual discriminability and was modified or replaced prior to retest was found to be discriminable. The mean percent correct responses made by the 22 subjects was identical with the performance of subjects in the main study (95%). Fourteen of fifteen model parts tested exceeded the test criterion of 85% correct responses.

The mouth opening on the Starfish model was not tested in the principal study but was modified and tested in the retest of the Starfish model. Despite the modification of the mouth opening, this model part failed to meet the test criterion in a test of legibility. The opening was located by 16 of 22 students (73%), and therefore, was not discriminable by the standards set for this study.

The failure of the mouth symbol was apparently caused by its similarity to the openings formed between the tube feet and body wall. Modification or replacement of the mouth opening or tube feet symbols was undesireable since each of these parts are realistic symbols which convey more information about these structures than an unrelated abstract symbol would reveal. It is suggested that the teacher note this difficulty and instruct students to identify the mouth by its location and in relation to other relevant body parts (e.g., its location on the opposite end of the model away from the tube feet; its proximity to the stomach).

Summary

Nineteen biological models were developed and the critical features on each model were tested for legibility. A 95% correct response overall was achieved by 42 legally blind students in the main study and an identical 95% correct response by 22 legally blind students was made on features which were modified or replaced on retest models. The criterion of discriminability 85% was not reached on the mouth opening on one model (Starfish). This set of biological models was produced and disseminated by the American Printing House for the Blind.

Task 7 Analysis of basic concepts in science textbooks, grades 1-3

Task Personnel Richard Baird

Purpose

The purpose of this analysis was to identify basic concept areas covered in primary science textbooks, to develop lists of related vocabulary, and to assemble a series of experiments and activities which could be used to illustrate the concepts. The concept areas and the related activities have been further divided into three levels of difficulty or sophistication. While these three levels generally correspond to grade level, it is not unusual to encounter substantial overlap at different grades. Concepts are included as they were presented in the texts, and not necessarily how they should have been presented. In some instances, activities have been included which were not found in the text when they offered particularly effective illustrations. This study was not only to identify concept areas but also to detail concept related activities taught and to identify the aids necessary to perform related operations.

Procedure

The analysis involved a detailed examination of all textual and pictorial material in four series of primary level science texts. The following series were included in the analysis:

a. Modern Science, Laidlaw Brothers, 1970.
b. Today's Basic Science, Harper and Row, 1963.
c. Science Around You, Ginn and Co., 1958.
d. Science Far and Near, D. C. Heath and Co., 1968.

Textbooks were analyzed by series from grade one through grade three. The first time a concept area was encountered, the area and related vocabulary and activities were recorded. From subsequent presentations of the same concept area additional vocabulary, activities, and levels of sophistication were added. This procedure was followed since it was more informative than a simple frequency count and, in addition, since there is evidence that frequency of occurrence is not necessarily a good reflection of educational significance (Franks, 1971). For this reason, one should avoid concluding that a given concept area is unimportant simply because this analysis, or the texts upon which it was based, devoted comparatively little space to that area. Frequently, two or more general concept areas shared common subject matter. Consequently, certain specific concepts and related vocabulary and activities may appear in more than one concept area. It should again be noted that both textual and pictorial material were reviewed to make the analysis as complete and comprehensive as possible.

Results

There were 25 basic concept areas identified in the study of those primary science textbooks listed. The following is a list of the concept areas:

The Scientist
Temperature
Phase Change, Insulation
The Seasons
Lightening, Electricity
Water Cycle, Evaporation-Condensation
Compass Direction
Magnetism
Gravity
Simple Machines
The Moon
Jets, Rockets
Soil
Erosion
Rocks, Fossils
Air
Sound, Hearing
Fire
Plants
Animals
Insects
Metamorphosis
Nose, Mouth
The Eye
The Skin

Each concept area presented includes in the report a list of related vocabulary, a series of experiments, and activities which could be used to illustrate concepts. Each of the concept areas is divided into three levels of difficulty, generally corresponding to grade level. The following is an example of the format used in outlining each of the concept areas.

Concept Area: The Scientist

Vocabulary	Aids Required
experiment	soda straws
control	salt

Concepts	Activities
LEVEL I	
Scientists observe, discuss, read, perform experiments, and keep careful records.	Discuss why the scientist must perform the above activities. Have the class keep daily records of plant growth, water evaporation or temperature.
LEVEL II	
Students, like scientist, can perform experiments and keep careful records.	Compare the waterline of soda straws floating in salt solutions of various concentrations. Make a Histogram of the results of the experiment. Discuss the various instruments of the scientist: The microscope telescope thermometer hand lens, Etc.
LEVEL III	
Scientists check their experiments by using a control experiment.	Discuss.

Conclusions

This study was stimulated by the junior high study (Task 1) reported previously. The concept areas identified and the breakdown on content at the primary grade level reported in the study have identified needs for several sets of educational aids for young blind students including:

1) A dial thermometer familiarization kit
2) An insect identification kit
3) A pull-apart cell
4) Simple machines

Work on the development of these and other materials will be initiated.

Task 8 Consumer panel meeting: Introducing basic science concepts to primary grade visually handicapped students (October 7-9, 1971)

Task Leader Frank Franks

Purpose

This meeting on primary science aids was held to inspect models of aids under development to examine concept areas in science where deficits are believed to exist, to identify aids for introducing specific concepts at the primary level, and to suggest priorities for developing additional instructional aids. Concept areas which are more appropriate for individual projects were also designated.

Participants

Mr. Norman Anderson, Maryland School for the Blind, Baltimore, Maryland

Miss Annette Bettinger, New York State School for the Blind, Batavia, New York

Mr. Anthony J. Biacchi, Educational Materials Research and Development Assistant, IMRC/APH, Louisville, Kentucky

Miss Betty Sue Hill, Owensboro Public School Vision Program, Owensboro, Kentucky

Mr. Roger A. Huff, Educational Materials Research and Development Assistant, IMRC/APH, Louisville, Kentucky

Mrs. Marian Lewis, Tennessee School for the Blind, Nashville, Tennessee

Mr. Vernon Lustick, Science Department, Missouri School for the Blind, St. Louis, Missouri

Mrs. Elise Nichols, Tennessee School for the Blind, Nashville, Tennessee

Mrs. Nellie Slaton, Frances Blend Elementary School for Blind and Partially Sighted, Los Angeles, California

Results

The following educational aids for young blind students were reviewed and suggestions made for their revision.

1) The dial thermometer, with a familiarization unit
2) A basic pull-apart cell
3) The insect identification unit
4) A set of simple machines, including the lever, the wheel and axle, the inclined plane, and the pulley.

The following recommendations were made in the meeting:

1) Existing instructional materials, kits, and individual aids in science available from commercial or specialized distributors should be evaluated to determine their usefulness for blind and partially seeing students. The best representatives of each should be considered for adaptation if they are found to have substantial instructional value for visually handicapped students (e.g., SCIS programs, Xerox science materials, rain gauge, light probe).

2) Instructional aids and materials should be developed which promote the young visually handicapped student's interest and involvement in science.

3) The need for developing three-dimensional aids to which concrete experiences and objects can be tied is emphasized. Such materials are recognized by the panel as important educational aids to assist young visually handicapped students in making better transitions from real animals, plants, and objects to the abstract raised-line drawings which attempt to illustrate these in braille textbooks.

4) Simplified pull-apart models with a minimum of detail should be considered when developing tactual materials.

5) Do not emboss braille on individual apparatus or materials. If and when this is appropriate, dymotape or other techniques can be used for labeling those parts which the teacher wishes to emphasize. It is felt that in pursuing a one-concept-at-a-time approach, no braille should appear on any apparatus when it is first introduced. Learning to manipulate or utilize an instructional aid should not be complicated by, nor the student distracted by, the appearance of braille characters on the aid.

6) All tangible apparatus and all discrimination exercises should provide both tactile and chromatic coding except for apparatus (e.g., the tactile ruler, the thermometer) developed specifically for nonvision students.

7) Instructional procedures for using instruments and aids developed and/or adapted should be provided for students' use, in braille and in large print when feasible.

8) Teachers' manuals for use of educational aids should be developed.

9) The utilization of cassettes, particularly with older students, should be explored.

10) Tangible apparatus and educational materials displayed at national and regional meetings and at special conferences should be supplemented with demonstrations by professional personnel who are qualified to discuss educational implications of the materials.

11) A general session of the AEVH convention should be devoted to primary science. In the AEVH Science Workshop, the final report of this meeting should be presented with members serving as a panel to discuss suggestions and conclusions recorded in the report.

12) Participants expressed concern and interest in education of visually handicapped students in public and residential school settings and recognized that visually handicapped students in public school programs integrated in sighted classes may have particular problems in science instruction which should be considered in the development, testing, and evaluation of instructional materials.

13) The extended utilization of APH science (and other instructional) materials in programs for multi-handicapped blind children should be considered.

14) The possibility of utilizing APH science (and other instructional) materials with children who have handicapping problems other than vision should be explored.

15) Participants in the primary science panel meeting agree to cooperate in so far as possible in the realization and implementation of the recommendations made herein.

Task 9 Development of the pull-apart cell

Task Personnel Frank Franks and Roger Huff

Purpose

The need for a simple cell model was stated by the consumer panel on instructional materials development in science (Task 2). Such a model would be used to introduce basic structural features of the cell to young blind students. The following suggestions and recommendations for the development of anatomical models by the Institute influenced the design of the cell prototype.

1) Detail should be kept simple.
2) As many models as possible should be pull-apart for tactual inspection.
3) Different textures for different body parts should be utilized to increase contrast.
4) Some larger than life models are needed for students in the elementary grades.

An Analysis of Basic Concepts in Science Textbooks, Grades 1-3 (Task 7) confirmed that the cell is introduced at the primary grade level. Inspection of numerous commercial and specialized catalogues, visitations to educational programs for the blind, inspection of various anatomical models, and interviews with educators of the blind failed to reveal any model suitable for use by young blind students.

The purpose of this study was to develop a cell model and to determine if young visually handicapped students could discriminate the textures appearing on the cell model, could locate and identify the cross-sectional cell layers, and could manipulate the pull-apart features of the cell model.

Procedure

Each subject was tested individually. A screen through which the subject placed his hands was used to occlude vision. The examiner provided a brief explanation of the type of science model the subject would examine. A test focusing on three measures of performance was administered. The first measure of performance consisted of 12 two choice match-to-sample discrimination tasks (four plastic styrene vacuum formed sheets). These tasks presented the symbols appearing on the cell schematic and required the subject to discriminate each. Three practice trials using different textures were presented to each subject to familiarize him with the match-to-sample format. The order of presentation of the test questions and the position of the answers on the sheets were randomized. For a two choice discrimination test, 67% of the subjects would have to correctly identify each discrimination task in order to demonstrate an above chance level of performance at $p < .01$ level of significance. The second measure of performance consisted of four identification-location tasks. Each task required the subject to identify a texture appearing on the cell schematic using a cue card format. Each subject was allowed one minute to examine the cross-sectional schematic prior to testing. Four cue cards were presented to each subject using permuted orders. Each cue card illustrated one of the four textures appearing on the cell model. The subject examined the texture on the cue card and was required to locate the identical texture on the cell model. For a four choice identification-location test, 39% of the subjects would have to correctly identify each discrimination task in order to demonstrate an above chance level of performance $p < .01$ level of significance. The last measure of performance consisted of a manipulation test involving six tasks. Each subject was asked to remove the cell cover, outer cell wall, and nucleus. After the cell had been taken apart, each subject was asked to put the cell back together. Six trials of one and one-half minutes each were specified as minimum criteria to accomplish each task. If a manipulation error occurred, the examiner explained the error to the subject and allowed the subject to perform the task again within a six trial limit. If a subject could not perform a manipulation task within six trials, the response was recorded as incorrect.

Materials

A pull-apart cell (schematic) illustrating the cross-sectional layers of a plant and/or animal cell was developed. The inner wall of the cell, protoplasm, and base were made of 15 mil vacuum-formed plastic styrene. The outer wall of the cell was removable and was constructed of a flexible rubber material. The nucleus was a removable core. The cross sectional model (schematic) was covered by a removable cell cover. Included with the aid for testing purposes were four cue cards illustrating the textures which appeared on each cell part and four sheets consisting of twelve discrimination exercises which introduced sequentially the textures used to identify each structural feature appearing on the cell model.

The instructional goals and performance tasks, on three sequential levels, included in the program are presented in Table 1.

Table 1
Instructional Goals and Performance
Tasks by Levels

Level	Instructional Goals	Performance Tasks
I	The student will discriminate likenesses and differences of surface areas used on the model of the cell.	Discrimination of color/texture patches using 1 1/2 inch squares. (e.g., Show me the patch which is different.)
II	The student will discriminate surface areas used on the model of the basic cell.	Identification of specific color/texture patches using one inch squares:

Table 1 (cont.)

Level	Instructional Goals	Performance Tasks
II (cont.)		Smooth/white Rough/red Grid/yellow (e.g., Show me the smooth white patch.)
III	The student will identify and manipulate the parts of a simple cell.	Identification/location and manipulation of the various parts of the cell as they appear on the model. Outer wall Inner wall Body of protoplasm Nucleus (e.g., Show the outer wall of the cell.)

Subjects

Sixty-seven visually handicapped students classified as tactile learners in grades 2-4 from the Ontario School for the Blind, Michigan School for the Blind, Western Pennsylvania School for the Blind, and the Ohio School for the Blind were tested. These students came from academic or regular classes. Six students were dropped because they did not understand the tasks to be performed in the evaluation. Nineteen subjects each were classified as second and third graders, and twenty-three subjects were classified as fourth graders. The means and standard deviations for their ages in years are as follows: Second grade $\bar{X}$ age = 7.78, SD = .85; Third grade $\bar{X}$ age = 9.42, SD = 1.46; and Fourth grade $\bar{X}$ = 11.13; SD = 1.42.

Results

The data were analyzed in terms of three measures of performance: (*a*) the percent number of correct discriminations on the two choice match-to-sample discrimination test, (*b*) the percent number of correct identification-location tasks, and (*c*) the percent number of subjects who accomplished the six tasks on the manipulation test within a six-trial limit.

On the two choice match-to-sample discrimination test results indicate the subjects as a group scored well above the chance level of performance (67%). Ninety-seven percent of the subjects correctly identified all of the discriminations while 3% of the subjects missed only one discrimination task. Correcting the obtained percentage (97%) for chance yielded a corrected percentage of 93%.

The second test in the evaluation involved four identification-location tasks. Results indicate the subjects as a group scored well above the chance level of performance (39%). Ninety-two percent of the subjects correctly accomplished all of the identification-locations tasks while 8% of the subjects missed only one task. Correcting the obtained percentage (92%) for chance error yielded a corrected percentage of 89%.

The final test in the evaluation consisted of six manipulation tasks. Results indicate that subjects as a group performed each manipulation task within the six trials allowed. See Table 2 for a summary of the percent number of subjects performing each manipulation task in one or more trials.

Table 2
Percent Number of Subjects Successfully
(N=61) Manipulating Pull-Apart Cell

Manipulation Tasks	Subject Percentage*; Successful Manipulation in one trial	Subject Percentage*; Successful Manipulation in two trials	Subject Percentage*; Successful Manipulation in three trials
1. Remove Cell Cover	89%	10%	1%
2. Remove Outer Cell Wall	100%		
3. Remove Nucleus	100%		
4. Replace Nucleus	100%		
5. Replace Outer Cell Wall	89%	8%	3%
6. Replace Cell Cover	90%	8%	2%

* Percentages rounded

The mean number of manipulation trials to complete each manipulation task was also computed. The mean number of trials to perform Task 1 was 1.13; Task 2, 3, and 4 was 1.0; Task 5 was 1.14; and Task 6 was 1.11.

Summary

The study evaluated the ability of young visually handicapped students to discriminate textures and to utilize them in locating and identifying the layers on a pull-apart cell model. The study also evaluated the ability of students to manipulate the pull-apart features of the cell model. The students as a group scored well above the chance level on discrimination and identification-location tasks. The students as a group were able to perform each manipulation task within the six trials allowed. These results confirm that young visually handicapped students in this study were able to perform the discrimination and identification-location tasks necessary for learning the parts of a simple plant and animal cell with pull-apart features. Ability of the students as a group to perform the essential manipulation tasks of taking apart and putting together cell parts also was confirmed.

This model was submitted to APH for production and dissemination.

Task 10 Development of the insect identification kit

Project Personnel Frank Franks and Roger Huff

Purpose

The Insect Identification Kit introduces the young visually handicapped student to insect models. The kit was developed to encourage students to improve their ability to discriminate size differences, to observe and to note differences and likenesses in insects, to learn the body parts of the insect, and to identify the insect when it appears with other small invertebrates on a model.

The kit was developed for use with real insects when possible. The advantage of the kit is its immediate availability in a climate and/or time when attempts to obtain live insects may be futile. Body parts often are difficult to identify on real insects because of their small size or their fragility. The insects in this kit were constructed larger than life size to make their parts more discriminable. A short line in the upper left hand corner on some of the models suggests the actual length of the insect which appears on the model.

The development of a set of three-dimensional models reproduced in vacuum formed styrene was suggested in the consumer panel on instructional materials development in science (Task 2). A review of the analysis of basic concepts in science textbooks, Grades 1-3 (Task 7) indicated that insects appear extensively in illustrations in primary science textbooks. While other small invertebrates (e.g., spiders, earthworms) appear regularly, the insect appears to predominate and was selected as a model to introduce the study of small invertebrates.

Concepts and activities in the primary science curriculum included inspection of common insects (and models), discussion of likenesses and differences in insects, identification of body parts, and observation of differences between the insect and other small invertebrates.

The primary purpose of this study was to determine if young visually handicapped students (grades 1-3) could learn to identify the basic body parts (six legs, three body parts, antennae) of an insect on a three-dimensional model using a set of training materials. Initially the students were to improve in their ability to discriminate size differences and to examine and to distinguish differences and likenesses in insects. A final model illustrating an earthworm, a spider, and an insect was included to determine if young visually handicapped students, upon completion of a training program, could identify an insect when it appeared with other small invertebrates.

Procedure

The criteria accepted for performance using the models was at least 80% correct response for braille and large print students on each model and for both groups combined.

Each student was trained and tested individually. The training program consisted of simple training exercises divided into three sections utilizing five models. The first section consisted of exercises designed to teach discrimination in size of insects (large, small, medium or in-between size) and discrimination of similarities and differences in insects (the ant, the beetle). Section two presented exercises for teaching identification of the body parts of the insect. An insect with wings (the bee) also was presented. Section three consisted of exercises for illustrating that insects are different from other small invertebrates (the earthworm, the spider).

The testing program consisted of 21 items using the five models. Because the three sections of the training program proceeded from simple to less simple operations, test items were administered upon completion of each section or sub-section. A breakdown of the testing program by model is summarized below.

The test focused on three measures of performance. The first measure of performance consisted of six discrimination tasks using two models. Size discrimination (smallest, largest, and medium-sized insect) was measured using Model I and "alike/different" discrimination (two ants and a beetle) was measured using Model II. The second measure of performance consisted of six identification tasks using two Models. Location of the basic body parts--six legs, head, two feelers, thorax and abdomen--was measured using Model III. Model IV was used to identify an insect with wings (a bee). The final measure of performance using Model V consisted of identification of the insect when it appeared with other small invertebrates (earthworm and spider).

Materials

A set of five models (schematics) on 15 mil vacuum formed styrene plastic sheets were developed. The outer dimensions of the plastic sheets were approximately 11 x 11 inches. The vacuum formed insect models range from 1 1/2" to 3 1/2" in length. The maximum height or rise of the insect models was kept to one-half inch. Black insects in relief on a white background were used to maximize contrast for use by subjects with minimal residual vision. Small invertebrates other than the insect were presented in contrasting colors (e.g., spider--brown, earthworm--red) on a white background.

The four models are pictured in a brochure contained in Appendix B.

The instructional goals and performance tasks, on three sequential levels, included in the program are presented in Table 1.

Table 1

Instructional Goals and Performance Tasks by Levels

Performance Level	Instructional Goals	Performance Tasks
1	The student will improve his ability to discriminate size differences and to note differences and likenesses in insects.	Identification of "largest", smallest", and "medium or in-between" sizes using models of the ant (e.g. Show me the largest insect.) and discrimination of likenesses and differences in insects using the model illustrating two ants and a beetle (e.g. Show me the insect that is different.)
2	The student will identify the body parts of the insect.	Identification of various body parts using models of insects (e.g. Show me the three body parts of the insect.) and identification of the insect with wings using the model of the ant and bee.
3	The student will distinguish the insect from other small invertebrates.	Identification of an insect when it appears with other small invertebrates such as the earthworm and the spider. (e.g. Show me the insect. The earthworm. The spider.)

Subjects

Seventy-one primary level (grades 1-3) students enrolled in residential and public school programs for the visually handicapped participated in this study. Twenty-four students were classified as braille-readers: grade one, 9 subjects; grade two, 8 subjects; grade three, 7 subjects. Forty-seven students were classified as large print readers: grade one, 18 subjects; grade two, 17 subjects; grade three, 12 subjects. The means and standard deviations for the ages of each grade level of both groups combined are as follows: First Grade $\bar{X}$ age = 7.6, SD = 1.55; Second Grade $\bar{X}$ age = 8.8, SD = 1.34; Third Grade $\bar{X}$ age = 9.8, SD = 1.42.

Results

The combined performance scores for braille and large print students on Level I, using Models I and II, ranged from 91% to 100%. These scores indicate that the insect models were tactually and chromatically discriminable when used with the program presented. A breakdown of percentages for braille and large print and for combined subjects correctly performing each discrimination task is presented in Table 2.

Table 2

Performance Scores in Percents* on Discrimination Tasks

(N = 71)	Model	Discrimination Tasks	Braille	Large Print	Combined
	1	Smallest ant	100%	100%	100%
	1	Largest ant	96%	98%	97%
	1	Medium-sized ant	92%	89%	91%
	2	Different insect	96%	98%	97%
	2	Two alike (ants)	100%	98%	99%
	2	One different (beetle)	96%	96%	96%

*Percents rounded

The combined performance scores for braille and large print students on Level II using Models III and IV ranged from 93% to 98%. These scores indicate that the young visually handicapped students in this study were able to identify the body parts using the program presented. The breakdown of percentages for braille and large print and for combined subjects correctly performing each identification task is presented in Table 3.

Table 3

Performance Scores in Percents* on Body Parts Identification Tasks

(N = 71)	Model	Identification Tasks	Braille	Large Print	Combined
	3	Find six legs	100%	96%	98%
	3	Find head	96%	100%	98%
	3	Find two feelers	88%	98%	93%
	3	Find thorax	96%	91%	94%
	3	Find abdomen	96%	91%	94%
	4	Find insect with wings	96%	100%	98%

*Percents rounded

Level III was presented using Model V to determine if young visually handicapped students could, upon completion of Levels I and II, identify the insect when it appeared with other small invertebrates (the spider and the earthworm). The model was prepared as an instructional aid for use by the teacher to teach that the insect is different from other small invertebrates and to encourage students to look for likenesses and differences among small invertebrates they study. Students first were asked to find the earthworm, then the spider, and finally the insect. The high performance scores (combined scores were 95%) on Level III for the third grade students indicate that the older students were better able to recognize the insect than the younger students. A breakdown of performance scores for each identification task is presented in percents by grade, by mode of reading, and for combined scores in Table 4.

Table 4

Performance Scores in Percents* on Identification of Small Invertebrates

(N = 71)	Grade	Identification Tasks	Braille	Large Print	Combined
	1	Find the Earthworm	(9) 89%	(18) 89%	(27) 89%
	1	Find the Spider	78%	72%	74%
	1	Find the Insect	78%	72%	74%
	2	Find the Earthworm	(8) 88%	(17) 94%	(25) 92%
	2	Find the Spider	75%	76%	76%
	2	Find the Insect	50%	82%	72%
	3	Find the Earthworm	(7) 86%	(12)100%	(19) 95%
	3	Find the Spider	86%	92%	89%
	3	Find the Insect	100%	92%	95%

*Percents rounded

Summary

The results of this study indicate that the young visually handicapped students participating in this study were able to learn and to identify the body parts of the insect represented on the models tested. Following the presentation of the models, these students were able to discriminate large, medium and small insects and to distinguish likenesses and differences between two ants and a beetle. They were able to identify body parts of the insect using the models. Third grade students were able to recognize an insect (the ant) when it was presented with other small invertebrates (the earthworm, the spider) on a model. Poorer performance scores by younger students on tasks in Level III may be due to developmental factors.

Task 11 Evaluation of the dial thermometer instructional unit

Project Personnel Frank Franks and Roger Huff

Purpose

The APH Dial Thermometer Instructional Unit consists of five vacuum-formed sheets in relief and one model of a dial thermometer face with a movable pointer. An accompanying training program was developed to familiarize young blind students with the tactual symbols used on the dial face and to introduce them to the operations involved in reading the APH Dial Thermometer included in the Science Measurement Kit.

A pilot study indicated that using a two choice match-the-sample format young visually handicapped students (grades 1-3) were able to discriminate the point, areal, and linear symbols appearing on the Dial Thermometer and were able to locate these symbols on a facuum-formed dial face using a key. The students also appeared to have grasped the concept of reading a dial thermometer. That is, they used zero as a reference point and moved from zero to ten degrees, to twenty degrees, etc., around the face in attempts to find symbols indicating 32°, 70-80°, and 150°. The pilot study was not adequate (too few items) to generalize to the young student's ability to identify specific symbols or reference points on the dial face as would be required in actually reading temperatures on a thermometer.

It was the purpose of this study to introduce the dial thermometer to blind students at the primary level (grades 2-4). Students were tested on their ability: 1) to locate and recognize the distinctive features (point, areal, and linear symbols) appearing on the dial thermometer schematic; 2) to locate specific lines on the dial thermometer schematic; and 3) to locate specified point and linear symbols using the pointer set by the examiner. Since the test focused on locating symbols, the program described herein did not attempt to include reading temperature *per se*. Reading temperatures includes understanding number concepts which were beyond the scope of this study. Specifically, the study tested the student's ability to identify a set of reference points on the dial face.

Procedure

The criterion accepted for performance on the evaluation was at least 80% correct performance on the tasks in the test for all grade levels combined.

Each subject was trained and tested individually. A screen through which the subject placed his hands was used to occlude vision. The training program consisted of a series of 54 training exercises divided into three sections. The first section consisted of 11 two-choice match-the-sample discrimination tasks which introduced the point, linear, and areal symbols appearing on the dial thermometer schematic. The second section consisted of 36 identification-location tasks which specified the location of the five symbols (key format) appearing on the dial thermometer schematic. Training involved identifying the symbols, locating the symbols on the schematic, associating symbols with different temperature readings, and counting linear symbols on the dial thermometer face. The third section consisted of seven simple identification tasks. Training involved locating and identifying a symbol which represented a specific temperature reading on a dial thermometer schematic. Three schematics appeared on one vacuum-formed sheet illustrating a pointer pointing to (a) 32°, a raised dot; (b) 70°-80°, a rough surface; (c) 150°, a raised line.

If a subject responded incorrectly to an operations task presented in the training exercises, the examiner provided the subject with the correct answer at the time the error was committed. The examiner then requested the subject to repeat the task. Correction was provided after each response until the subject successfully performed the task. Each subject was allowed up to five trials to correct an error. The examiner recorded the number of trials necessary to respond correctly to an operational task within the five trial limit.

Following the training exercises a test focusing on three measures of performance was administered. A schematic of a dial thermometer with a movable pointer was utilized. The first measure of performance focused on locating and recognizing distinctive features of the dial thermometer using a cue card format (eight questions). The examiner presented the subject with a cue card on which a distinctive feature appeared (e.g., a raised circle, a raised dot, a raised rough surface, and the pointer). After examining the distinctive feature on the cue card, the subject located the identical feature on the dial thermometer schematic. The second measure of performance focused on locating specific symbols on the dial thermometer schematic (eight questions). The subject used the raised circle as a reference point for zero and was directed to locate specific lines from zero. The third measure of performance focused on using the pointer to locate linear and areal symbols on the dial thermometer schematic (14 questions). The examiner set the pointer on the dial thermometer to a specified temperature reading. The subject then examined the pointer and was required to locate the symbol closest to the point of the pointer.

Materials

The APH Dial Thermometer Instructional Unit consists of five vacuum-formed dial thermometer face with a movable pointer. Sheets 1, 2, and 3 consist of symbol discrimination tasks which require the subject to identify two identical symbols in a series of three. Sheet 4 presents symbol identification-location tasks on a dial thermometer schematic using a key. Sheet 5 presents tasks in identifying one point, one areal, and one linear symbol on each of three dial thermometer schematics without use of a key. The Fahrenheit dial thermometer face with movable pointer is three inches in diameter. Temperature is indicated in ten degree units (around the dial face) by one-fourth inch lines that are approximately .040 inches high. Both freezing point (32°F) and boiling point (212°F) are marked with a braille dot some .050 inches high. The interval from 70 to 80 degrees Fahrenheit is indicated by a rough textured surface raised to approximately .050 - .060 inches. This textured ten degree interval enables students to measure temperatures of liquids at room temperature more easily and serves as a reference point between freezing and boiling points. Zero degrees Fahrenheit is indicated on the training schematics by a raised circle.

Subjects

Sixty-one subjects classified as tactile learners in grades 2-4 from the Ontario School for the Blind, the Michigan School for the Blind, Western Pennsylvania School for the Blind, and the Ohio School for the Blind were tested. Five students were dropped because they did not understand the tasks to be performed in the evaluation. Seventeen subjects were classified as second graders, eighteen subjects as third graders, and twenty-one subjects as fourth graders. The means and standard deviations for their ages are as follows: Second Grade $\bar{X}$ age = 7.82, SD = .88; Third Grade $\bar{X}$ age = 7.50, SD = 1.46; Fourth Grade $\bar{X}$ age = 11.0, SD = 1.41. These students came from academic or regular classes.

Results

The data were analyzed in terms of three measures of performance: (a) the percent number of subjects who were able to locate and recognize the distinctive features appearing on the dial thermometer schematic, (b) the percent number of subjects who were able to locate specific lines on the dial thermometer schematic, and (c) the percent number of subjects who were able to locate specified point and linear symbols using the pointer set by the experimenter.

On locating and recognizing distinctive features which appeared on the dial thermometer schematic, results indicated that the subjects as a group attained a high level of performance and experienced little difficulty in performing the eight location-recognition tasks. One hundred percent of the subjects located and recognized four distinctive features on the dial thermometer schematic; any raised line, the raised circle, the raised rough surface, and the pointer. Eighteen percent of the subjects were unable to locate and recognize the first line, 5% of the subjects were unable to locate and recognize the raised dot closest to the third raised line, 7% of the subjects were unable to locate and recognize the raised dot closest to the twenty-first raised line, and 2% of the subjects were unable to locate and recognize the point of the pointer. Performance scores in percents for each locational task are presented in Table 1.

Table 1

Locating Symbols on the Dial Thermometer Schematic (N = 61)

Locational Task	Percentage* of Subjects Correctly Performing Location Task
1. Any raised line	100%
2. First raised circle	82%
3. Raised rough surface	100%
4. Raised dot closest to third raised line	95%
5. Raised dot closest to twenty-first raised line	93%
6. Point of pointer	98%

*Percentages rounded

The second measure of performance required the subjects to count specified numbers of raised lines using the raised circle as a reference point for counting. Results indicated that at least 84% of the subjects performed each counting task correctly. Table 2 summarizes the percentage of subjects correctly performing each counting task.

Table 2

Counting Linear and Areal Symbols on the Dial Thermometer Schematic (N = 61)

Counting Task	Percentage* of Subjects Correctly Performing Counting Task
1. Fourth raised line	100%
2. Seventh raised line	96%
3. Ninth raised line	98%
4. Twenty-second raised line	93%
5. Raised rough surface	100%
6. Eighth raised line	96%
7. Sixteenth raised line	84%
8. Twenty-first raised line	93%

*Percentages rounded

The final measure of performance involved 14 locational tasks using the pointer on the dial thermometer schematic. The examiner set the pointer pointing to a symbol representing a specific temperature reading. Each subject placed his finger on the symbol closest to the point or small end of the pointer. One hundred percent of the subjects located the eight symbols representing the following temperature readings; 60°, 90°, 200°, 0°, 70°, 160°, 150°, and 140°. Two percent of the subjects were unable to locate four symbols representing the following temperature readings; 40°, 80°, 20°, and 220°. Fifty-three percent of the subjects were unable to locate the symbol representation 30° and 43% of the subjects were unable to locate the symbol representing 210°. Performance scores for each locational task using a pointer are presented in Table 3.

Table 3

Locating Linear Symbols Closest to the Small End of the Pointer (N = 61)

Locational Tasks	Percentage* of Subjects Correctly Performing Locational Task
1. 40°	98%
2. 60°	100%
3. 80°	98%
4. 90°	100%
5. 20°	98%
6. 200°	100%
7. 30°	47%
8. 210°	57%
9. 0°	100%
10. 70°	100%
11. 160°	100%
12. 150°	100%
13. 140°	100%
14. 220°	98%

*Percentages rounded

Summary and Conclusion

The results of this study indicate that the majority of young blind students tested were able to locate and recognize the point, areal, and linear symbols on the dial thermometer schematic, to locate specific lines, and to locate specified point and linear symbols using the pointer as set by the examiner. However, students were unable to reach the criterion level in locating the linear symbols representing 30° and 210°.

The tasks comprising the final measure of performance involved locating the symbol closest to the small end of the pointer. The examiner set the pointer pointing toward a specific symbol. The subject in turn identified the symbol closest to the pointer. The point symbols 32° and 212° are immediately adjacent to the lines representing 30° and 210°. In a majority of cases the examiner observed the subjects locating the point symbol instead of the linear symbol as a result of a masking effect. To prevent further errors in locating these temperatures, a note to the teacher has been included in the instructional unit and in the brochure to instruct the student to identify the 30° raised line and the 32° raised dot and the 210° raised line and the 212° raised dot. The student is to note that, moving clockwise, the raised line immediately precedes the raised dot. Consequently these symbol configurations become reference points on the dial thermometer face. Variations in symbol size and heighth to minimize the masking effect also will be explored.

Task 12 Adaptation of the primary level: simple machines

Project Personnel Frank Franks and Larry Butterfield, Jr.

Purpose

Inspection of primary science textbooks confirms the fact that increasing numbers of physical science activities are appearing in the primary science curriculum (Task 7). While specific concepts (e.g., friction, force, resistance) are not always formally introduced in the primary grade texts, simple machines illustrated in a number of concept related activities do appear pictorially with little or no verbal explanation of the operations illustrated. These activities are introduced under such headings: Push and pull, doing work, lifting things, working with ramps.

The lever, the inclined plane (ramp), and the wheel are introduced as early as first grade in some science series. The wedge, the screw, the pulley, and the wheel and axle are introduced by grade three. The fixed and the movable pulley are defined by grade three in some science texts.

Six commercially available simple machines were identified which appeared adaptable for use by blind children. Of the six simple machines, the wedge and screw required no adaptations. Initial adaptations were made to the lever, inclined plane, wheel and axle, and pulley. These four adapted simple machines were reviewed by a consumer panel. The following recommendations were made (Task 8).

Lever:

1) A balance arm that really balances should be included.
2) Provision should be made on the balance arm for the use or accommodation of weights.

Inclined Plane:

1) A removable retainer should be placed before the wheel of the inclined plane to keep the cart from jumping the wheel and falling over the edge. The retainer should be removable for use with older students.
2) The cart should have two side panels added. With only end panels to contain them, weights can slip off the cart distracting younger students. The side panels should be lower than the end panels.

Wheel and Axle:

1) The axle will operate more efficiently if it is shortened.
2) An additional cross notch on the axle elevation control will provide additional stationary positions.

Pulley:

1) Modifications should be made on the apparatus to simplify introduction of concepts using the fixed and the movable pulleys.
2) The positioning of one pulley should not interfere with the operation of the other pulley.
3) Some provision for attaching a weight to the movable pulley should be made.

These adaptations were made to the four machines. The machines were then presented to a group of young blind students. Further refinements were made to the machines based on observations of blind students performing manipulation tasks using the machines.

The purpose of this study was to evaluate young visually handicapped students' ability to identify and manipulate the parts of each of the following adapted simple machines: lever, inclined plane, wheel and axle, and pulley.

Procedure

The criteria accepted for performance using the simple machines was at least 80% correct response for each machine by all subjects combined.

Each subject was trained and tested individually. Legally blind students with useful amounts of vision were trained and tested using blindfolds. The four machines were presented in the same order to each child. The training program for each machine consisted of identification and manipulation activities. Because of its early appearance in texts, the lever was presented first. The lever evaluation program consisted of tasks that required the subject to place the lever arm on the resting point of the base at various positions and to place weights on the hooks at the ends of the lever arm. The wheel and axle and inclined plane were presented next because of their order of appearance in science texts. The wheel and axle evaluation program consisted of tasks that required the subject to place the axle in the hole in the base, put the string in place, use the string to raise and lower a weight and start and stop the wheel from turning. The inclined plane evaluation program consisted of tasks that required the subject to place the cart in the grooves of the inclined plane, move the cart up and down to the stops, add a weight to the end of the string, and make the incline higher and lower. Because of its complexity, the pulley was presented last. The pulley evaluation program consisted of tasks that required the subject to place a string on the fixed pulley, use the string to raise and lower a weight, place a string around the movable end of a fixed pulley, and use this string to raise and lower a weight.

Materials

Commercially available models of simple machines from the Crusader Science Collection (Crusader Toys, San Marcos, California 92069) were adapted. According to the manufacturer, the collection was designed for preschool through sixth grade students to aid them in understanding the basic principles of the physical sciences and mathematics. All machines are made of durable high quality hardwood.

These machines were adapted for use by young visually handicapped students to learn basic physical science concepts. The size of each machine and the concepts introduced at the primary grade level for each machine follow.

The lever: (Size 18" x 6")

1. A lever is a long bar that can balance on a resting point.
2. If equal weight is distributed on both ends of the balance arm, the lever will balance.
3. If force is applied to only one end of the balance arm, the other end will move in the opposite direction and the arm will be out of balance.
4. If weight is added to the other end of the balance arm, the other end will move the opposite direction and the arm will be out of balance.
5. If the same amount of weight is added to both ends of the balance arm, the arm will remain in balance.

The inclined plane: (Size 16" x 7")

1. A ramp is a surface which is higher at one end.
2. The upper end of the ramp can be different heights.
3. A ramp becomes steeper as its upper end becomes higher.
4. A ramp can be short or long.
5. The longer the ramp, the less the force required to move an object.
6. The steeper the incline, the greater the force required to move an object up the ramp.
7. It is easier to move a load up an inclined plane than to lift the same weight.

The wheel and axle: (Size 16" x 9")

1. A wheel and axle turn together.
2. A wheel and axle can lift or lower objects.
3. The wheel is larger than the axle.
4. A wheel and axle require less effort in lifting an object than an axle.
5. A wheel and axle turn the same number of times.
6. A wheel and axle turn in the same direction.
7. A wheel goes through a longer distance than the axle.

The pulley: (Size 16" x 5")

1. A pulley is a wheel that turns on an axle.
2. A pulley is a machine that makes it easier to lift or move things.
3. There are two types of pulleys: fixed and movable.

Subjects

Twenty-seven legally blind students in elementary classes from the Florida School for the Blind and the Indiana School for the Blind participated in the evaluation. These students came from academic or regular classes. The age range of these students was from 7 to 13 years old. Prior studies in the educational materials development in primary science have focused on grade levels. Because of the lack of equal number of subjects in each grade, subjects in this study were considered on the basis of chronological age.

Results

The high performance scores on each of the simple machines indicates that young visually handicapped students in this study were able to successfully complete manipulation tasks using the training program. Successive t-tests were used to determine if the performance of older vs. younger visually handicapped students was significantly different. Although the older students did score higher on three of the four machines tested, the difference between the two groups were not significant. Results of the t-tests were: The lever ($t = 0.7675$, $df = 25$, $p > .05$), the wheel and axle ($t = 0.5690$, $df = 25$, $p > .05$), the inclined plane ($t = 0.7929$, $df = 25$, $p > .05$), and the pulley ($t = 0.2837$, $df = 25$, $p > .05$). The overall performance scores and the standard deviations for older vs. younger groups on manipulation tasks are reported in Table 1.

Table 1
Percent of Correct Response on Manipulation Tasks

Machines	Percent of Correct Responses* (n = 27)	Younger Group (N = 13)	Older Group (N = 13)
Lever	98%	96%	99%
Wheel and Axle	97%	98%	96%
Incline Plane	94%	93%	96%
Pulley	92%	91%	93%

*Percentages rounded

Summary

The study evaluated the ability of young visually handicapped students to identify and manipulate the parts of the lever, the inclined plane, the wheel and axle, and the pulley. The high performance scores for each machine confirms the ability of the students in this study to perform identification and manipulation tasks considered basic to learning fundamental physical science concepts which the machines were adapted to teach. Performance scores for older vs. younger students revealed no significant differences between the two groups.

Task 13 Compilation of a light probe manual

Project Personnel Frank Franks

Purpose

Participants in two consumer panels (Tasks 2 and 8) were enthusiastic about the potential uses of the light probe as an instrument for introducing a number of laboratory science experiences to young blind students. They felt that a number of concept-related activities could be performed for the first time by blind students using the light probe. Participants in Task 8 designated the light probe as the highest priority educational aid to be included in the APH research and development program for young blind students in science.

The purpose of this project was the development of a manual of basic science experiments using the light probe to introduce concepts in life science, earth science, and physical science.

Procedure

Light probes distributed by the Royal National Institute for the Blind in England were sent to six science teachers for use with young blind students. The task for the teachers was to identify a variety of classroom experiments which the light probe enabled the students to perform. Experiments were actually performed independently by young blind students or with teacher assistance. The successful experiments were then sent to APH for inclusion in a manual of experiments. Following return of the experiments, they were reviewed, classified, and drafted in manual form. Copies of this draft were then reviewed by the teacher participants and a final draft made.

Participants

Mr. A. H. Evancic, Western Pennsylvania School for Blind Children, Pittsburgh, Pennsylvania

Mr. Ross L. Huckins, California School for the Blind, Berkeley, California

Mr. Norman Anderson, Maryland School for the Blind, Baltimore, Maryland

Mrs. Marian Lewis, Tennessee School for the Blind, Nashville, Tennessee

Mrs. Elise Nichols, Tennessee School for the Blind, Nashville, Tennessee

Mrs. LaRhea Sanford, Florida School for the Blind, St. Augustine, Florida

Materials

The light probe contains minature electronics within a small cylindrical metal case. The case has a conical nose carrying a small plastic lens. A small 1 1/2 volt battery drives the device and a milled edge cap at one end of the cylinder activates an on/off switch. The electronics is basically an audio oscillator having a variable musical pitch dependent on the light intensity falling on the lens behind which is a light sensitive transister.

Pitch of the oscillator signal rises with increase in light intensity.

Results

Following is a partial list of the concepts included in experiments in the manual.

A strong light source is necessary for maximum efficiency in the use of the light probe.

The light probe must be pointed directly at the object to be observed for the best interpretation.

The sound pitch of the light probe increases as intensity of the light increases.

The light probe changes pitch as it is moved to varying intensities of light and color change.

White, black, and gray squares can be matched using the light probe.

Light and dark shades of clothing can be detected using the light probe.

The amount of material inside a container can be determined by using the light probe.

Light passes through transparent materials.

Transparent materials reflect some light.

The moon does not have light of its own. It reflects light from the sun.

The rotation of the earth causes:
    a) Light during the daytime
    b) Darkness at night
    c) An increasing amount of light in the morning
    d) A decreasing amount of light at night

Light will not travel through opaque materials.

When opaque materials are placed in the path of light rays, a shadow is produced.

Electricity is used to produce light.

Electricity flows when there is a complete circuit.

A switch is used to open (break) and close a circuit. The light is on when the circuit is complete. It is off when the switch is up and the circuit is broken.

Carbon dioxide can put out a fire.

Many of our foods contain starch, a form of carbohydrate.

Litmus paper changes colors when placed in acids and bases.

Chlorophyll and sunlight are necessary to produce food in a plant.

A thermometer operates on the expansion-contraction principle.

Buoyancy is determined by the relationship of the weight of a substance as compared with the weight of an equal volume of water.

Electrolysis can be used to separate some compounds into two different substances.

A solid displaces water.

Sample experiment

Concepts to be developed. A strong light source is necessary for maximum efficiency in the use of the light probe.

The light probe must be pointed directly at the object to be observed for the best interpretation.

The sound pitch of the light probe increases as intensity of light increases.

Vocabulary. Pitch--light probe--intensity.

Materials required. 2 sheets of construction paper (black and white)--3 intensities of light--light probe.

Experiment. Have three lights set up in a row. Let the student use the light probe to find which of the light sources is the brightest. Which is the dimmest?

Practice pointing the light probe directly at a light source or a specified reflective object.

Place a piece of black construction paper and a piece of white construction paper beside each other on a table. Notice the difference in the sound of the light probe as it is moved from one piece of paper to the other. Try this under a bright light and under a dim light. Is there a difference in the sound? Discuss.

Task 14 Individualized Science Activities

Project Personnel Carson Nolan and Frank Franks

Purpose

The goal of this project was to provide science activities for visually impaired students in the elementary grades. Severely visually impaired students are handicapped in learning science because of their inability to learn vicariously through observation of pictorial material in textbooks or classroom demonstrations. More importantly, most science experiments rely heavily on visual processes in handling equipment, making measurements, and recording results. In contrast, the activities developed in this project were designed to emphasize the receptive and response capabilities of visually impaired students. All were designed to give the student a personalized experience in science and to develop the student's independence in exploring various types of equipment and scientific concepts. The course of this project was strongly influenced by results of the Adapting Science Materials for the Blind project carried out by the Lawrence Hall of Science, University of California at Berkeley. This project involved adaptation for the blind of the elementary science curriculum developed in the Science Curriculum Improvement Study.

Procedure

The project was a cooperative venture between IMRC personnel and staff of the Lawrence Hall of Science. In the initial interaction between these groups, these general specifications for the development of kits of science materials were defined: (a) The materials should be useful at the elementary grades, (b) They should reflect a broad range of science topics, (c) The materials should be individualized, (d) They should emphasize discovery, and (e) They should each contain activities at several levels of difficulty.

On the basis of these general specificitions, 25 science activities were identified for development by Lawrence Hall personnel. Specifications for all of these were written and models for 10 of them were developed. These were reviewed in a joint meeting of the cooperating groups. Twenty of the activities were selected for further development. Modifications and revisions for these 20 activities were outlined during this meeting.

Subsequent to this meeting, Lawrence Hall personnel developed the 20 sets of materials. During the development, each set was subjected to formative evaluation in classrooms for the visually impaired of the California School for the Blind or Castro Valley, California public schools. Upon completion of this second phase of development, copies of the refined model of each activity were sent to the IMRC for review.

The twenty sets of activities were reviewed by IMRC staff as well as by an expert elementary science teacher of the visually handicapped. The results of these reviews were discussed with Lawrence Hall personnel in a final meeting. It was agreed that eight activities should be further refined, the necessary numbers of copies manufactured, and distributed for independent field trials after termination of the IMRC grant.

Materials

Each kit developed consisted of a set of materials necessary to perform the activities as well as written instructions for the students. The instructions first listed the materials necessary to complete the activities. This was followed by an experiment for which the steps required for successful completion were laid out sequentially. Questions for the student to answer based on the experimental procedures followed. Response to these questions served to indicate whether the student had understood the experiment and had been able to perform it successfully. The first experiment was followed by several additional experiments suggested to the student in the form of challenges. In order to complete these experiments, it was necessary for the student to develop his own procedures using the material included in the kit. An example of the written instructions accompanying the kit for "Bottle Sounds" as given below.

BOTTLE SOUNDS

EXPERIMENT: Produce two different tones from the same bottle by blowing over the opening of the bottle.

Equipment to use:

*2 eight ounce Coke bottles (same size, same shape)
alcohol pads (for cleaning bottle tops)
water
1 one ounce cup
* (supplied by teacher)

EXPERIMENTS TO PERFORM

Activities to do:

1. Set up two bottles. Leave one empty. Fill the other one with 3 cups of water.
2. Blow across the top of each bottle. Listen to the sounds that you make.

Questions to answer:

3. Blow across each bottle top until you get a clear tone. Compare the tones. Do they produce different tones? Yes _____ No _____

   Does the bottle with the water in it produce a higher or lower tone?
   ____

4. How many cups of water would you have to put in the empty bottle to get a higher tone than the tone produced by the bottle containing three cups of water? ________________________________
____

5. A variable is something that can be changed. In an experiment usually one variable is changed while all other things are kept the same. In this activity you changed the amount of water in the bottles. The amount of water in a bottle is a variable, and it made a difference in the tone produced by the bottle. Name other variables (things) you can change in an experiment that affects the tone produced when you blow over the top of a bottle. ________________
____

CHALLENGES TO TRY

Equipment to use:

1 box of salt
*3 bottles (2 of the same size and shape)
1 funnel
water
* (supplied by teacher)

alcohol pads (for cleaning bottle tops)
1 metal spoon
1 one ounce cup

BOTTLE SOUNDS CHALLENGE #1: Produce the same tone from two different shaped bottles by blowing over the top of the bottles.

BOTTLE SOUNDS CHALLENGE #2: Find out if salt can be used instead of water to change the tone produced by blowing over the end of a bottle.

BOTTLE SOUNDS CHALLENGE #3: When you tap bottles with a metal spoon, find 3 variables (things) that affect the tone produced.

BOTTLE SOUNDS CHALLENGE #4: Find a musical instrument that you blow into. Compare the sounds produced by the bottles to this instrument. What do you have to do to this musical instrument to produce different tones?

Results

Kits for 20 different science activities for use by visually impaired students in the upper elementary grades were developed and revised on the bases of trial use with students and expert reviews. These kits included the following experiments.

1. Table Sounds - Produce different sounds while blowing over the mouth of a tube through varying tube length and diameter.

2. Bottle Sounds - Show how sounds produced by blowing over the mouth of a bottle can vary with bottle contents, size, and shape.
3. String Board - Produce different tones from the same string when it is plucked by variation of string length and tension.
4. Sliding Board - Show how the angle of incline at which a block slides down a board varies with friction.
5. Absorption - Find out if different kinds of materials will absorb equal or varying amounts of water.
6. Make a Better Ice Cube Keeper - Find out how containers composed of varying materials compare in keeping ice from melting.
7. Mystery Boxes - Determine the location and shape of a block placed within a box by the sound made by a marble sealed in the box.
8. Coils - Find out how the capacity of an electromagnet to pick up metal discs varies with the number of coils of wire wrapped around it.
9. Container Exchange - Identify containers of different shape which hold the same quantity of material.
10. Sound Box - Discover how illumination effects the frequency of sound given off by a sound box (light sensor).
11. Reflect or Not to Reflect - Determine which piece of material can reflect more light (with light sensor).
12. Stop that Light - Find out which materials allow the most and least light to pass through (with light sensor).
13. Bounce that Light - Discover how light reflectance varies with cards ranging in shades of gray from white to black.
14. How Bright is That Light - Pick out the light bulb emitting the most light.
15. Using the Light Sensor - Using a single constant light source, find several ways to make the tone of the light sensor vary.
16. Catch That Light - Where must the light sensor be located to receive the same amount of light from two light bulbs which emit different amounts of light.
17. Swinging Sounds - Make a pendulum that swings back and forth five complete swings in five seconds.
18. Hello Heart - Find out how rate of heart beat varies with body dimensions.
19. Pumping Pulse - Find out if your pulse is different in different parts of your body.
20. Reaction - Find out if your reaction time varies between your right and left hand.

Conclusion

Twenty science activities for visually impaired elementary students were developed and refined. Other funding must be obtained before these materials can be evaluated further.

CHAPTER SIX

DEVELOPMENT OF MATHEMATICS MATERIALS

Descriptions of thirteen tasks related to development of mathematics materials are included in this chapter. Initial efforts involved brief surveys of student attainment in residential and public schools in order to identify general needs. Three analyses of mathematics textbooks helped to pinpoint these needs. Still greater focus was achieved through a meeting of a consumer panel in early 1970. On the basis of these needs identification efforts, seven materials development projects were undertaken. The materials developed and evaluated in these projects included the geometric area and volume aid, a numberline, geometric forms, a large abacus, an aid for teaching fractional parts of wholes, a tactual ruler familiarization kit, and programmed abacus instruction. All these materials with exception of the last were adopted for production and dissemination by APH.

Task 1 Arithmetic computation: achievement of visually handicapped students in residential schools

Project Personnel Roy Brothers

Purpose

It has been over a decade since Nolan and Ashcroft (1959) evaluated the Braille adaptation of the Stanford Achievement Test (SAT) for arithmetic computation. In the course of the evaluation, considerable attention was focused on the computational abilities of the participating students. Nolan and Ashcroft concluded that 75 percent of the students were below grade level and that they were scoring an average of 15 percent below the norm which was based on a sighted population.

A follow-up analysis of the same data by Nolan (1959) revealed that there were significant differences in achievement between schools, that differences were relatively constant across grade levels within a school, and that the rate of achievement was highly variable.

In the years since the Nolan and Ashcroft evaluation, the literature has been generally concerned with the development and use of computational devices or strategies which might facilitate arithmetic computation. Results of a pilot study by Nolan and Bruce (1962) indicated that blind children in the primary grades could approximate or exceed the arithmetic achievement norms for sighted children after participating in an experimental curriculum. Tangible aids used to implement this special curriculum were the Numberaid, a type of abacus for counting and performing simple operations, and the Calculaid which is a Braille numerical recording device (Nolan, 1964).

Davidow, Germain, and Rice (1964) reported a study by Essex which found that fifth and sixth grade students using the Japanese type abacus adapted by Cranmer, and produced at the American Printing House for the Blind, definitely improved their accuracy and speed of computation. Nolan and Morris (1964) noted that the average computational skills of junior high students using the Cranmer abacus improved by as much as 66 percent over an eight-month period.

Lewis (1970) has reported results of a survey which focused on computational devices and teaching strategies currently used in mathematics programs throughout the country. The abacus and Braillewriter were the most commonly reported devices, along with mental calculations, which should be considered more of a computational strategy. Lewis suggested that a study was needed to determine the current status of arithmetic achievement and to determine whether the student's use of certain techniques or devices were reflected in their achievement scores.

Table 1
Age Range, Median Age, Mean IQ, and Number
of Students at Each Grade Level

	Grade 3	Grade 4	Grade 6	Grade 8
Age Range (yrs.-mo.)	6-11--14-5	9-2--14-2	10-10--17-4	13-2--20-11
Median Age (yrs.-mo.)	9-11	10-11	12-11	15-11
Mean IQ	90.4*	92.3*	94.2*	97.9*
_N_	52	76	60	81

*IQ scores not available for all students.

Table 2
Percentage of Students Using Specific Device
or Strategy at Each Grade Level

Device or Strategy	Grade 3	Grade 4	Grade 6	Grade 8
Mental Computation (no device)	28.8	40.0	20.0	35.8
Numberaid	26.9			
Braillewriter	17.3	7.8	6.6	19.7
Cranmer Abacus	3.8	15.7	50.0	28.3
Abacus plus other device or strategy	11.5	11.8	10.0	9.8
Numberaid and/or Calculaid		15.7		
Braillewriter plus other device or strategy				4.9
Other devices (Taylor Slate, sticks, Cubarithm board, pencil & paper, numberline)	11.5	7.8	13.3	1.2

Results

Classification of students according to the device used was more difficult than anticipated. The regular test procedure called for parts one and two to be administered on successive days. Thus it was possible for a student to use an abacus on day one and a Braillewriter on day two. In this particular instance the designation of device group or computational strategy would be abacus plus other supplementary device. The exact reasons for students changing devices on the second day are not known. However, in several instances students in this classification were identified

The purpose of the present study was threefold.

(1) To determine the current achievement level of Braille students in arithmetic computation.
(2) To compare achievement scores of Braille students on the SAT test of arithmetic computation for the years 1959 and 1970.
(3) To explore possible relationships of SAT achievement scores with the type of computational device or strategy used by Braille students.

Procedure

In most respects the current evaluation was conducted using the prodedures described by Nolan and Ashcroft (1959). Braille students in grades 3, 4, 6, and 8 were again tested using the SAT. All four levels of the arithmetic computation test were used; the Primary test was administered to grade three, the Intermediate I test to grade four, the Intermediate II test to grade six, and the Advanced Level test to grade eight. All tests were administered during the latter part of October 1970, which represented the passage of .2 of a school year.

Eight of the nine schools represented in the 1959 study participated once again. However, in order to obtain a representative number of students at each level, students from four additional schools were included in the present sample. The only other change that may be associated with the procedure was in using Form X rather than Form J of the SAT. The tests were administered at each of the schools by regular school personnel. The administration of the tests conformed to directions found in Stanford Achievement Test Forms W and X Directions For Administering Braille Editions (1965). All test materials were returned to the American Printing House for the Blind where they were scored and checked.

In addition to the SAT materials, a short questionnaire was also directed to each test administrator. The questionnaire served a dual purpose. First, background information describing the students was obtained, and secondly the student's preference or use of a computational device was noted. This information was necessary in order to note any relationships between device or strategy used and the student's achievement score.

Subjects

Table 1 provides information concerning the age range, median age, mean IQ, and the number of students participating at each grade level. The students tested in 1970 were generally younger for their grade than their counterparts in the 1959 study. The ages as reported in Table 1 were from 5 to 11 months younger than median ages reported for similar grade levels in 1959.

as being new to the school or a beginning user of the device. Approximately 30 percent of the students elected to use no device at all. For purposes of classification these individuals were assumed to be using mental arithmetic as their computational strategy. Table 2 indicates the percentage of students using a particular device or strategy for each of the grade levels tested. It should be noted that at the primary level a Braillewriter was necessary to record answers, since this level does not use a multiple-choice format for answering. The teachers, in monitoring the test and responding to the questionnaire, distinguished between the Braillewriter as a recording and/or computational device; consequently they only reported the Braillewriter when it was being used in the computational process. The devices most frequently used by the students were the abacus, Numberaid, Braillewriter, and Calculaid, which support the findings of Lewis (1970).

Table 3 presents the first, second, and third quartile points from the distribution of grade-norm scores for each grade level in 1959 and 1970.

Table 3
Grade-Norm Scores for the Four Groups:
Years 1959* and 1970

Grade Level and Expected Achievement	Q^1 (25% point) 1959	Q^1 (25% point) 1970	Q^2 (Median) 1959	Q^2 (Median) 1970	Q^3 (75% point) 1959	Q^3 (75% point) 1970
Grade 3.2	2.2	1.6	2.5	2.1	2.8	2.7
Grade 4.2	2.8	2.6	3.7	3.1	4.2	3.5
Grade 6.2	4.1	3.6	5.2	4.6	6.0	5.4
Grade 8.2	5.6	5.2	7.1	6.4	8.4	8.1

*Nolan and Ashcroft, 1959

The achievement levels of the 1970 group were consistently below those levels reported in 1959. In reference to the 1970 group 88 percent of the scores fell below the expected level of achievement. Normally, it would be expected that closer to 50 percent of the Ss would score below an established norm. A further inspection of Table 3 revealed that the median scores reported in 1970 fell below those levels of 1959 by 4 to 7 months in the third and eighth grades respectfully.

The students' achievement scores according to device or strategy group are presented in Table 4. Several interesting relationships between device used and achievement score were observed. The small and uneven numbers of students using a particular device limited the application of statistical tests which would have demonstrated conclusively the superiority of a particular device. However, combining the device or strategy groups at the eighth grade level into a mental arithmetic, Braillewriter plus other device, and abacus plus other device group, a median test was possible (Siegel, 1956).

Table 4
Mean Achievement Scores of Students Using Specific
Device or Strategy at Each Grade Level

Device or Strategy	Mean Achievement Scores* Grade 3	Grade 4	Grade 6	Grade 8
Mental Computation (no device)	2.26	2.94	5.01	6.54
Numberaid	2.64			
Braillewriter	1.87	2.80	4.45	5.67
Cranmer Abacus	1.70	3.08	4.66	7.61
Abacus plus other device or strategy	1.95	3.38	3.58	6.75
Numberaid and/or Calculaid		3.68		
Braillewriter plus other device or strategy				6.30
Other devices (Taylor Slate, sticks, Cubarithm board, pencil & paper, numberline)	2.08	2.50	3.76	4.50

*grade score

The median test resulted in a χ^2 value of 8.97. With df = 2 the $.05>p>.02$ which provided evidence that the device used was associated with the level of computational achievement.

Table 5 presents the mean achievement score and IQ of grade 8 students according to device or combination of device and strategy. The expected positive relationship between level of IQ and achievement was not evident. Rather surprisingly, the highest achievement level was attributed to the group having the lowest mean IQ. It was noteworthy the device used by this group was the abacus or abacus and another device or strategy.

Table 5
Mean Achievement Score and IQ for Grade 8 Students
Using a Particular Device or Device Combination

Device or Strategy	N	Mean Grade Score Expected Grade Score 8.2	Mean IQ
Mental Arithmetic (no device)	29	6.54	98.9*
Abacus or Abacus plus other device or strategy	31	7.39	91.5*
Braillewriter or braillewriter and other device or strategy	20	5.79	105.9*

*IQ scores not available for all students

Discussion

The results clearly indicate that the overall achievement of Braille students in arithmetic computation has not improved over the past decade. While the group in 1959 achieved approximately 15 percent below the sighted norm (Nolan & Ashcroft, 1959), those tested in 1970 were approximately 27 percent below the norm. It may be argued that the caliber of student now enrolled in residential schools is not comparable to those enrolled 10 years ago. In the years 1966 to 1969, residential school enrollments dropped approximately 2 percent while the enrollment of children in all other programs increased (Nolan & Bott, 1971). In addition it was found that in the period 1960 to 1969 the enrollments of residential schools decreased approximately 15 percent while local school enrollment increased by about 11 percent. Much of the increase may be attributed to the additional opportunities afforded visually handicapped students to attend their local school programs. At the same time Wolf (1967) reported the higher prevalence of concomitant disabilities among children attending residential schools.

The student's prior experience with a device was not known, and it should be recognized that mastery of a specialized aid such as the abacus requires both time and adequate instruction. The data in Table 4 would suggest that, once introduced, the rate of achievement for students using the abacus was greater than any other group. It was observed that 43 percent of the students in the eighth grade abacus group were achieving at or above the expected grade score of 8.2.

Many questions may be posed concerning the student's actual choice of a device. What degree of confidence did he have in the device chosen? Was he encouraged to use a specific device or strategy? Did the student's repertoire of skills include the use of other devices so that a choice was possible? The fact that one device or strategy was eventually selected would suggest some degree of confidence in it, and further information from the individual schools would undoubtedly provide partial answers to the other questions. The emphases placed on mathematics instruction at the various schools (Nolan, 1959) would also be reflected in the teachers' training and their expectations regarding student performance. For example, teachers at those schools adopting the Individualized Mathematics Curriculum (Nolan & Bruce, 1962) attended special training workshops which acquainted them with all aspects of this experimental program. The positive aspects of this special training effort are highlighted by the data in Table 4 which indicated that the achievement scores of students using the Numberaid and/or Calculaid were higher than all other device groups at the third and fourth grade level. While there are apparent advantages in using such experimental materials, the actual number of teachers trained in their use was rather limited. For example at the fourth grade level, teachers at only 3 of the 12 schools reported any student using the Numberaid or Calculaid. The availability of teachers prepared to teach the abacus may also be questioned. While 9 of the 12 schools reported some of their students using the abacus, the overall percentage of abacus users was close to 45 percent. It would certainly be a sad commentary if students were being deprived of an effective educational aid because trained personnel were not available to provide instruction and supervise its use.

Educational Implications

Consider first the grade level at which students are introduced to specific computational devices. The results suggest the use of the Numberaid and Calculaid in the third and fourth grades. Although the majority of teachers in these grades may not be thoroughly familiar with their use, they are examples of concrete manipulative devices which aid in the computation and recording processes. The results also suggest that the Cranmer Abacus may be successfully introduced at the fourth grade level. Such an early introduction would assure adequate time for the student to consolidate the computational skills so necessary for later success at the advanced and secondary levels.

A type of selection process may also exist regarding the instruction and use of specific devices or strategies. Some students appear to be more likely candidates for abacus instruction. In the present sample, students using the abacus also happened to have the lowest mean IQ scores of any group. It is recognized that a teacher may be hesitant to introduce a new device especially when the students performance appears to be adequate. However the ever-increasing complexity of the computational processes must also be considered. Mental arithmetic or the use of a Braillewriter may be adequate at the primary or early intermediate grades, but, as indicated in Table 5, these approaches are not sufficient at the advanced level. If students are to realize their full potential in mathematics a comprehensive program should be adopted.

Lewis (1970) reported the widespread use of the Braillewriter for mathematics computation both in residential and public school programs. Table 2 indicated that the highest percentage of students in the current sample who used the Braillewriter were in the eighth grade. This may suggest that younger students have been encouraged to place less emphasis on the Braillewriter as a computational device. This would appear to be a highly promising trend. The results of the study suggest that any one of several devices would be superior to the use of the Braillewriter at any of the four grades tested.

While results of the study indicate that arithmetic computation remains a critical area within the curriculum, positive alternatives have been identified and await the action of educators. These include: (1) the use of the Numberaid or other concrete manipulative device at the third and fourth grade level, (2) providing an opportunity for all students to become proficient with the abacus by the completion of grade six, and (3) placing much less emphasis on the Braillewriter as a computational aid.

Task 2 Arithmetic computation: Achievement of visually handicapped students in public schools

Project Personnel Roy Brothers

Purpose

In the course of evaluating the Stanford Achievement Test (SAT) for arithmetic computation, Nolan and Ashcroft (1959) found that the achievement level of braille students was generally low. In the decade following that study various computational devices such as the Cranmer Abacus and the Numberaid were adapted and/or developed to meet the special needs of blind students. A follow-up study by Brothers (Task 1) focused on the current levels of arithmetic achievement and the computational devices or strategies that were being used by braille students in residential schools. Results indicated median grade achievement scores were 4 to 7 months below scores reported for similar grade levels by Nolan and Ashcroft. However, the achievement scores of students who used the abacus and Numberaid were significantly higher than groups of students engaged in using other devices or strategies.

Since both studies focused on the achievement of braille reading students in residential schools for the blind, it was recommended that visually handicapped students in public schools be similarly tested.

The purpose of the present study was to determine current achievement of visually handicapped students in the area of arithmetic computation, to determine what computational devices were used by the students, and to explore relationships between devices used and the achievement level attained.

Procedure

Visually handicapped students in public school programs, grades 4, 6, and 8 were selected as the target population. Eleven states were identified as having a relatively large number of students meeting the grade criterion. Geographically the states represented northern, southern, eastern, north central, and western sections of the country. Proceeding on the assumption that districts supporting programs for braille students would also have a large number of legally blind students using large type, school districts having two or more braille students enrolled in the target grades were identified. Ultimately, 52 districts in 10 states were contacted and invited to participate in the evaluation.

Three levels of the SAT, Form X, Arithmetic Computation were used in the evaluation. The Intermediate I level was administered to Grade 4, the Intermediate II level to Grade 6, and the Advanced Level to Grade 8. Braille editions were used for braille students and special forms of the test prepared in 18-point type were used for the remaining students at each grade level. All tests were scheduled for administration during the first two weeks in February.

Directions for testing were sent to all participating schools and tests were administered by regular school personnel. In addition to monitoring the testing, test administrators completed a short questionnaire which provided background information about the student and noted the computational device and/or strategy which was used. All test materials were returned to APH for scoring and analysis.

Results and Discussion

A total of 263 students representing 42 school districts in 10 states were tested. Table 1 provides information relative to the reading mode, median age, and number of students at each grade level. It was estimated that the sample represented 24% of the braille readers, and 9% of the large type students enrolled in the target grades of public school programs. The estimate was based on the number of students enrolled in grades 3, 5, and 7 in 1971 (APH, 1971).

Table 1

Reading Mode, Median Age, and Number of Students at Each Grade Level

	Grade 4		Grade 6		Grade 8	
	Braille	Lg. Type	Braille	Lg. Type	Braille	Lg. Type
Median Age	10-7	10-1	12-5	12-2	14-6	14-3
N	34	56	35	53	28	57

In the academic year preceding the study the 42 participating districts had enrolled approximately 380 visually handicapped students in grades 3, 5, and 7. In terms of the 263 visually handicapped students that were tested the attrition rate approached 32%. Many schools reported that students had moved or were no longer in the program, some students did not advance to the next grade, and a number were not tested upon the recommendation of school personnel. The extent to which results were effected by this selection process is not known.

The February test administration represented the passage of .5 of a school year and was used in specifying the expected grade score. Table 2 presents the mean grade expected score, obtained mean grade scores, and standard deviations for braille and large type students. A comparison of mean scores revealed no significant differences between scores of the braille and large type students at any grade level.

Table 2

Mean Grade Scores and Standard Deviations for Braille and Large Type Students

Grade Level and Expected Achievement	Braille Students		Large Type Students	
	$\bar{X}$ Grade Score	SD	$\bar{X}$ Grade Score	SD
Grade 4.5	4.1	1.19	4.1	1.37
Grade 6.5	6.3	2.20	5.8	1.76
Grade 8.5	7.6	2.55	8.0	2.40

In grades 4, 6, and 8 the percentage of students scoring below the median were 69%, 67%, and 61% respectively. A Binomial Test indicated these percentages were significantly below the expected median. The values obtained for grades 4, 6, and 8 were: $z = -3.48$, $p < .001$; $z = -3.09$, $p < .001$; $z = -1.95$, $p < .025$ (Siegel, 1956). Although a significant number of the students scored below the expected median the extent of the difference was less than previously noted in the literature. Previous data have indicated braille students scored an average of 16% to 27% below the norm (Task 1; Nolan & Ashcroft, 1959). In the present study the mean scores of braille students were approximately 8% below expected achievement levels and large type students averaged 9% below grade level.

Tables 3 and 4 indicate the percentage of braille and large type students who used a particular device or computational strategy. It was surprising to find that fewer than 15% of the students at any grade used the abacus. For similar grades in residential schools, Task 1 found the abacus was used by 27.5% of the braille fourth graders, 60% of the sixth graders, and 38.1% of the eighth graders. In the present study over 70% of the braille students at all grade levels used the braillewriter or cubarithm board for their computations. The extensive use and general acceptance of these devices pose an interesting question. Is their appeal related to how well they aid in the computational task or is it because alternative strategies are not developed? These devices may be used effectively to set-up or structure the problems in order to achieve correspondence with a visual written representation. It then becomes possible for visually handicapped students to follow the same procedure or computational process that sighted students would use in solving the problem. However, once the basic process is understood, continued adherence to visually oriented procedures tends to ignore research results supporting the efficacy of the abacus as a computational aid especially suited to the needs of the visually handicapped (Task 1; Lewis, 1970; Nolan & Morris, 1964).

Table 3

Percentage of Braille Students Using Specific Device or Strategy at Each Grade Level

Device or Strategy	Percentage of Student Users		
	Grade 4	Grade 6	Grade 8
Board & Cubes or Board & Cubes plus other strategy	17.6	42.8	25.0
Braillewriter or Braillewriter plus other strategy	55.9	45.7	50.0
Mental Arithmetic	8.8	2.8	3.6
Abacus or Abacus plus other strategy	14.7	8.6	10.7
Other devices			10.7
Device not reported	2.9		

Table 4

Percentage of Large Type Students Using Specific Device or Strategy at Each Grade Level

Device or Strategy	Percentage of Student Users		
	Grade 4	Grade 6	Grade 8
Mental Arithmetic	17.9	11.3	17.5
Pencil and Paper	46.4	64.1	43.8
Pencil and Paper plus mental arithmetic	14.3	11.3	28.0
Abacus or abacus plus mental arithmetic and pencil (recording)	5.3	-	-
Other Devices: (fingers, blackboard; multiplication matrix; numberline)	12.5	5.7	1.8
Device not reported	3.6	7.5	8.8

Mental arithmetic, especially for the braille student, has generally been accepted as being an integral part of the mathematics curriculum. It was interesting to note therefore that two to four times as many large type students were reported as using mental arithmetic as their braille reading counterparts.

The achievement scores associated with a specific device or strategy are presented in Tables 5 and 6. There were relatively few abacus users among the students tested, but the scores obtained would tend to support the efficacy of the device for both braille and large type students. The cubarithm board was used most effectively by the eighth grade braille group. The braillewriter group scored slightly above the other device groups at the sixth grade level, but similar differences were not demonstrated at the eighth grade level. Increasing problem difficulty and errors in setting up the problem have been suggested as reasons for decreased effectiveness of the braillewriter at the advanced levels (Task 1).

Eighth grade students using pencil and paper plus mental arithmetic scored higher than all other device groups. A comparison of mean scores showed a significant difference between those who used pencil and paper only and those who used these aids plus mental arithmetic ($\underline{t} = 2.57$, $\underline{p} < .02$). Large type students who used the abacus in the fourth grade scored well above expected grade level, but further comparisons were not possible since the device was not used by large type students in the sixth or eighth grades.

Table 5

Mean Achievement Scores of Braille Students Using Specific Device or Computational Strategy

Device or Strategy	Mean Achievement Scores		
	Grade 4	Grade 6	Grade 8
Board or Slate & Cubes	4.1	-	-
Board & Cubes or Board & Cubes plus other strategy	-	6.3	8.9
Braillewriter or Braillewriter plus other strategy	4.0	6.6	7.0
Mental Arithmetic	4.6	2.0	5.4
Abacus or Abacus plus other strategy	4.7	6.3	7.7
Other Devices	-	-	8.6

Table 6

Mean Achievement Scores of Large Type Students Using Specific Device or Computational Strategy

Device or Strategy	Mean Achievement Scores		
	Grade 4	Grade 6	Grade 8
Mental Arithmetic	3.9	7.4	7.0
Pencil & Paper	3.9	5.7	7.7
Pencil & Paper plus mental arithmetic	4.5	7.0	9.6
Abacus or Abacus plus mental arithmetic	6.2	-	-
Other Devices	3.1	3.4	4.5

The differences in achievement between the device groups cannot be attributed solely to the device used. Certainly achievement is effected by such variable as IQ, prior experience with the device used, and curricular emphases.

Educational Implications

Results of this study and the previous assessment (Task 1) suggest that program goals, objectives, and teaching strategies should be reexamined to insure the special needs of the student are being met. Devices selected for use in computation should reflect the grade level content, the immediate task, and future needs. The use of different devices at various grade levels should be considered. Such an approach would afford greater opportunities for the student to become familiar and proficient with several computational strategies. The student could then make personal judgments regarding the device or strategy which will best meet his future needs.

Task 3 Frequency of geometric illustrations in mathematics textbooks, grades 1-6

Project Personnel Marvin Murr

Purpose

Graphic illustrations in mathematics textbooks constitute a major mode of information to the sighted student. However, the wealth of educational instruction inherent in these illustrations is practically inaccessible to the majority of blind students. Educational materials developers can partially remove this instructional deficit by depicting mathematical concepts in tactile displays.

Geometric concepts are often complex and not easily described in words. Graphic illustration of these concepts is viewed as an invaluable source of information about them. The visual mode of presentation of these illustrations is all but inaccessible to the blind student and a tactile analog must be made available if he is to gain the information which they, sometimes uniquely, convey.

The purpose of this study was to determine the types and frequency of occurrence of various geometric concepts commonly found in mathematics textbooks for the elementary grades. Once these facts are established, materials developers have a sound basis for initiating development programs in accord with the finding of this research. Priorities in this program should reflect the importance placed on various concepts as shown by their relative textual treatment.

Procedure

A textbook analysis was made of all textural and illustrative material in two series of elementary level mathematics textbooks. The following series were included in the analysis:

a. Modern School Mathematics, Houghton Mifflin Co., 1967. (H-M)
b. Elementary School Mathematics, Addison-Wesley Publishing Co., Inc., 1963. (A-W)

Each series of textbooks contained six books, one for each grade level. Each book was inspected, page by page, for any illustrations which showed geometric concepts or used geometric figures (triangle, circle, etc.) to demonstrate other mathematical principles. Types and frequencies of illustrations were recorded on a separate sheet of paper. Concept and frequency criteria were established to define "what" concept occurred and "how many" times. Where two or more geometric concepts were involved, category criteria were used to resolve the question of whether one complex or several individual principles were presented. When two or more identical concepts were shown, frequency criteria were employed to define "one occurrence" of the concept.

Results

Data collected in this study reflect 236 separate geometric concepts. These numerous concepts were divided into six categories reflecting increasing complexity. The categories and their defining characteristics were as follows:

I. Elements. Basic, tangible geometric concepts.
II. Plane Figures. Two-dimensional simple closed curves.
III. Space Figures. Three-dimensional closed surfaces.
IV. Abstract Concepts. Concepts of geometric relationship.
V. Constructions. Geometric drawings and model building.
VI. Theorems and Postulates. Proven geometric propositions and accepted assumptions.

A comparison of category frequencies revealed that plane figures (5835) were, by far, the most numerous type of illustrations, though elements (1825) and abstract concepts (1172) still appeared quite often. Space figures (536) occurred about half as frequently as abstract concepts, while constructions (139) and theorems and postulates (133) are relatively rare on the average.

A trend of increasing concept frequency was noted with progression through grade levels. Its causes were increasing frequency levels of elements , space figures, abstract concepts, and theorems and postulates. Plane figures decreased with increasing grade levels while constructions remained constant, once they appeared.

When the H-M textbook series was compared to the A-W series for concept frequency, the H-M series was found to contain more illustrations in every concept category, except constructions, and at every grade level, except first. Of particular significance were the categories of "elements" and "abstract concepts", where the H-M textbooks contained more than twice the number of the respective A-W frequencies, and "theorems and postulates", where this ratio reached treble proportions.

This analysis supported the need for the set of introductory geometric forms developed for young blind students. Additional development of educational aids in introducing geometric concepts to young blind students will be shaped by information referenced in the six areas reported in the analysis.

Task 4 Primary geometric concepts in elementary mathematics

Project Personnel Roger Huff

Purpose

The emphasis on the mathematics curricula made available within the past ten years has shifted from rote memory work, repetitive exercises, and unrelated clusters of mathematical facts to one of a conceptual understanding of mathematics as a system of related ideas based on logical descriptive and visual processes. As this is the approach for developing modern mathematics programs it becomes the task of the educational researcher to identify the conceptual deficits a particular population of exceptional children are experiencing and to plan a systematic approach to materials development which will supplement remediation techniques employed in the classroom.

In this study mathematics textbooks were analyzed to identify the learning objectives presented in the curriculum, techniques the author employed in presenting concepts, visual illustrations occuring on the printed page which facilitate learning, and the interplay of concrete and abstract examples which illustrate mathematical functions. Specifically, the analyses performed resulted in reference material which provide the following breakdown:

1) Range and sequence of topics, associated vocabulary, and suggested instructional aids
2) Geometric concept analysis by grade
3) Performance operations in geometry by grade

Procedure

An analysis of the following primary level mathematics series which identified the range and sequence of topics, associated vocabulary, and suggested instructional aids in the geometry concept area was conducted.

1. Addison Wesley Series, Elementary School Mathematics, Books 1 through 3. (1963, 1964)

2. Science Research Associates Series, Greater Cleveland Mathematics, Books 1 through 3. (1962)

3. Silver Burdett Series, Modern Mathematics through Discovery, Books 1 through 3. (1965)

4. Laidlaw Series, Mathematics, Sets, Numbers, Numerals, Books 1 through 3. (1963)

5. Houghton Mifflin Series, Modern School Mathematics Structure and Use, Books 1 through 3. (1967)

The instructional objectives of each text series were defined in relation to the importance placed on understanding geometric concepts at the primary level. The following guidelines used to identify geometric concepts were drawn from the Greater Cleveland Mathematics Program (1968).

1. Questions are emphasized more than answers.
2. Reasoning and understanding are stressed rather than memorizing rules.
3. Every effort is made to develop an idea prior to the use of words that name the idea. Language is useless without ideas; the language of math is learned as the pupil participates in the developmental activities.
4. Many of the activities require the child to manipulate objects and make generalizations.
5. Basic facts are learned by referring to a model or picture.
6. Models or pictures are used to develop the concepts associated with the operation.
7. Visual models are used extensively in deepening perception of number structure.
8. Models or pictures are presented as theoretical or real life examples.

Results

As a result of this analysis a number of topic areas, terms, and instructional aids were identified for grades 1-3 which have direct implications for development of educational materials in mathematics for young blind students. A list, by grade level, is presented below.

Range and Sequence of Topics	Associated Terminology	Suggested Instructional Aids
Grade I		
1. Identification of circles, squares, triangles, & rectangles 2. Comparison of different sized circles, squares, triangles, rectangles 3. Ideas of points & line segments (3) 4. Closed curve (1) 5. "The shortest distance between 2 points is a straight line" (1)	above after angle area before below between center center point chord circle closed compass congruent	ruler number line toys of different sizes plane models in wire and/or plastic in various sizes (Judy Property Blocks & Stick-O-Mats, square with a 10" diagonal, square corner, etc.) flannel or magnetic board and geometric shapes solid models (cube, etc.)

Grade II

1. Ideas of inside, outside, on, region (1)
2. Drawing & using points & line segments including diagonals (2)
3. Center, radius, & diameter of a circle
4. Square corners
5. Symmetry (2)
6. Congruence (1)
7. Simple closed curves including circles, squares, triangles & rectangles (1)
8. "Only 1 line can be drawn through 2 points, but many lines can be drawn through 1 point." (1)

cube
cylinder
diagonal
diameter
end point
graph
inside
larger
last
left
line
line segment
next
opposite
outside
parallel
parallelogram
path
plane

compass & desk protector
tracing paper
simple street map
squared paper
book with squared corners
volleyball, basketball, baseball
classroom globe
magazine pictures of geometric shapes
1/4" wide strips
thumbtacks

Grade III

1. Regions of a plane (inside & outside) & properties of plane figures
2. Drawing circles with a compass (1)
3. Parallelogram & parallel lines (2)
4. Angle, exterior & interior angles (1)
5. Constructing right angles
6. Quadrilaterals
7. Cube & its properties (1)
8. Sphere
9. Cylinder (1)
10. Constructing rectangles & squares by folding paper (1)
11. Families of lines through a point (1)
12. Family of circles through 2 given points (1)
13. Three points not on 1 line determine exactly 1 circle (1)

point
quadrilateral
radius
rectangle
region
right
right angle
roundness
shape
shortest
sides
simple
smaller
space
sphere
square
square corner
symmetric
triangle
volume

heavy string
crayons
paste
scissors

Summary

The analysis suggested a number of educational aids for development for young blind students. Consequently, the following educational aids are suggested for immediate development:

1) An introductory geometric forms kit which consists of thermoform raised line figures of circle, square, and triangle on plastic sheets; of tangible plane figures of circle, square, and triangle; and of three-dimensional solids of a sphere, a cube, and a pyramid.

2) A tactile numberline

3) A fractional parts of wholes kit

Task 5 Consumer panel meeting: Materials development in mathematics for visually handicapped (April 9-11, 1970)

Project Leader Frank Franks

Purpose

The purpose of this meeting was to examine areas in mathematics where deficits in instructional materials for visually handicapped are believed to exist, to identify specific aids necessary for teaching basic concepts in these areas, and to suggest priorities for development of relevant aids and materials.

Participants

Dr. Robert Bruce, Virginia School for the Blind, Staunton, Virginia

Dr. Mae Davidow, Overbrook School for the Blind, Philadelphia, Pennsylvania

Mr. A. H. Evancic, Western Pennsylvania School for Blind Children, Pittsburgh, Pennsylvania

Mrs. Dixie Howser, Kentucky School for the Blind, Louisville, Kentucky

Mr. Daniel Kopecky, Texas School for the Blind, Austin, Texas

Mrs. Harold Sachs, East Meadow, New York

Mr. Ralph E. McCracken, Editorial Department, American Printing House for the Blind, Louisville, Kentucky

Results

A number of mathematics aids were recommended for development and/or adaptation. These include:

1) Simple geometric forms
2) Hollow geometric forms
3) Plane figures
4) 3-D materials
5) Large abacus
6) Number line
7) Place value device
8) Put-together kits
9) Fractional equivalents and decimals equivalents aid
10) Intermediate geometric forms
11) Linear measurement aids
12) Graph board
13) Raised line drawing kit
14) A quadrant board with grid
15) Coordinate 3-D aid
16) Pythagorean theorem triangle set
17) Slide rule

18) Kit for geometric drawings and constructions
19) Protractor
20) Compass

The following recommendations were made at the meeting:

1) Existing instructional materials, kits and individual aids in mathematics available from commercial distributors should be evaluated to determine their usefulness for blind and partially seeing students. The best representatives should be considered for adaptation if they have instructional value for visually handicapped students.

2) The IMRC should alert central catalog users to materials available in mathematics which have proven useful to visually handicapped students, without adaptation. These materials should be evaluated by educators or specialists who have used the aids or have seen them in use in educational programs.

3) Participants recommend the abacus as the best mathematical computational aid available at the present time. Along with the four fundamental processes of mathematics computation with whole numbers, the abacus can be used in computations with fractions, decimals, extracting of roots, percentages, conversion to different bases, ratio and proportion, logarithms, etc.

4) Instructional procedures for using instruments and aids developed and/or adapted should be provided in elementary language in braille and in large print.

5) Teachers' manuals for the above should be prepared where possible, with guidelines for use in various curriculum areas across grades.

6) Appropriate IMRC personnel should be available to demonstrate at regional centers and meetings, at in-service programs, and at special conferences, tangible apparatus and equipment developed for visually handicapped students. Emphasis would be on demonstration as opposed to display of materials.

7) Participants expressed concern and interest in education of visually handicapped students in public school and residential school settings, and recognize that visually handicapped students in public school programs integrated in sighted classes may have particular problems in instruction which should be considered in the development, testing and evaluation of instructional materials.

8) Educational aids review meetings, in other academic areas, similar to this meeting should be considered.

9) Relevant information from this and other meetings should be made available to educators in the field

10) Participants in the Mathematics meeting agree to cooperate insofar as possible in the realization and implementation of the recommendations made herein.

Task 6 Primary mathematics textbook analysis grades 1-3

Project Personnel Eleanor Pester

Purpose

Before special tangible apparatus for the visually impaired can be developed, guidelines are needed to provide specifications and priorities for aids development. Such guidelines are often provided through some form of textbook analysis (Caton, 1969). It was the purpose of this study to identify through textbook analysis the concept areas (e.g., addition, measurement, geometry), their scope and sequence of development on each of the three primary grade levels, with the vocabulary and aids suggested as guidelines for tangible apparatus development.

Procedure

The most recent teachers' editions of the mathematics textbook series now being produced in braille at the American Printing House for the Blind (APH) were analyzed. These series were as follows:

(a) Addison-Wesley (A-W)
(Eicholz, Martin, Brumfiel, & Shanks, 1967 & 1963)
(b) Science Research Associates (SRA)
(Elementary Staff of the Educational Research Council of America, 1968)
(c) Laidlaw (L-B)
(Gundlach, Welch, & Buffie, 1968 & McSwain, Brown, Gundlach, & Cooke, 1965)
(d) Silver Burdett (S-B)
(Morton, Gray, Rosskopf, & Trafton, 1970)
(e) Houghton Mifflin (H-M)
(Duncan, Capps, Dolciani, Quast, & Zweng, 1967)

Each series was color coded by the investigator. A pencil of an assigned color was used for initial recording of data from a series. If a subsequent series contained the same data, a check mark or page numbers and supplementary information was added to the original recording in the appropriate color. This procedure saved unnecessary time in re-recording the same data on different sheets, and made possible a frequency count for the series without further compilation of the data.

The initial recording of data from the textbooks was done on information sheets which have evolved from previous textbook analyses of the Instructional Materials Reference Center, APH. These information sheets were also color coded. (Mathematics information sheets were pink.) Information sheets contained space for recording such data as grade level, concept area, concepts taught, vocabulary, and suggested aids for developing the concepts. Each textbook was examined lesson by lesson and relevant information was recorded.

Following the initial textbook analysis, the data were organized by general concept areas to indicate the scope and sequence of concept development on the three primary grade levels, the vocabulary used, and the suggested aids for developing each concept area in primary mathematics. The general concept areas identified were ranked according to their frequency of appearance in the five series on the three primary grade levels. Numbers in parentheses indicated the number of series which presented a particular concept at that level.

Textbook analysis indicated that many of the suggested aids overlapped general concept areas; i.e., the same aids were used for teaching a number of concepts. Consequently, all of the suggested aids identified in this study were categorized by type, and the information was consolidated for easy reference in one table. On this list were superimposed the aids recommended for development by the oncsumer panel on mathematics materials (Task 5) and those recommended by Caton (1969) to supplement illustrations in braille textbooks.

Results

Table 1 indicates the twelve general concept areas suggested by this analysis of primary mathematics textbooks and the number of series including these concepts on each of the three levels.

Table 1
Concept Areas Ranked by Frequency of Appearance in the Five Primary Textbook Series on Each Grade Level

Concept Areas	Grades 1	2	3
Set Theory	5	5	5
Addition	5	5	5
Subtraction	5	5	5
Our Number System and Place Value	5	5	5
Fractions	5	5	5
Money	5	5	5
Measurement	5	5	5
Geometry	4	4	5
Multiplication	1	5	5
Ordinal Numbers and Location	3	4	2
Division	-	2	4
Roman Numerals	-	2	2

Examination of the data revealed that seven of the concept areas were included on all primary levels in all textbook series. These important areas were set theory, addition, subtraction, our number system and place value, fractions, money, and measurement. Geometry was covered at all primary levels by four of the five series; the fifth did not introduce geometry until grade 3. Only one series introduced multiplication in grade 1; all series presented multiplication in grades 2 and 3.

Because of the variety of material covered in the concept area of measurement, it was advantageous to further subdivide this category. Table 2 presents this subdivision.

Table 2
Subdivision of Measurement Ranked by Frequency of Appearance in the Five Primary Textbook Series on Each Grade Level

Concept Area: Measurement	Grades		
	1	2	3
Linear	5	5	5
Liquid	5	5	5
Clocks	3	4	4
Calendars	2	3	3
Temperature	-	2	3
Weight	-	-	2
Dozens	-	1	1

Linear and liquid measurement were the most important subdivisions, appearing in all series at all grade levels. Clocks, surprisingly, did not appear in one series at all, and were not introduced until grade 2 in another.

A compilation of the tangible apparatus suggested in the five textbook series is presented in Table 3. The eight subheadings--set collections, place value aids, number sequence aids, fraction aids, measurement devices, geometric aids, miscellaneous arithmetic aids, and general classroom supplies--were used for convenience in organization. Superimposed on this table are the aids recommended for development by the mathematics consumer panel (Task 5) and those recommended by Caton (1969) to supplement illustrations in braille textbooks. Many of the aids, especially those that have not been recommended in either of these previous studies, have been satisfactorily adapted for the visually impaired or are available commercially in a form which can be used by the visually impaired without adaptation.

Table 3
Primary Arithmetic Aids Suggested in 5 Textbook Series for Grades 1-3

Set Collections

counting objects (washers, colored beads, spools, clip clothespins in 3 colors, sticks, tongue depressors, straws, checkers, poker chips, 2-color disks)
different colored cups & saucers
paper dolls & dresses
toys of different sizes
lettered or textured blocks
10 different small objects
egg cartons

Number Sequence Aids

number line
number strips or colored rods
follow-the-dot puzzles
sequence chart to 100
decades chart to 200

Measurement Devices

clock with synchronized hands
clock with Roman Numerals
yardsticks
foot rulers (cm.)
calendar
thermometer for demonstration
scales (kitchen & bathroom)
calibrated cup
liquid measuring containers
meterstick
outdoor thermometer
individual thermometers
individual clocks
odometer

Place Value Aids

containers labelled "Ones," "Tens," "Hundreds"
counting men
abacus or number frame
real or toy coins & money
1,000 plain blocks
regrouping sets (bundles of sticks, pop-together beads, etc.)
Judy Place-Value Pegs

Fraction Aids

fractional parts & wholes
objects able to be cut apart to demonstrate (paper plates, apples, candy bars, geometric paper shapes)
non-hardening modelling clay

Geometric Aids

magazine pictures of shapes
models - (wire and/or plastic in various sizes) cube, square corner, square with 10" diagonal, etc.
compass & desk protector
volleyball, basketball, baseball
classroom globe
Judy Stick-O-Mats
circular objects (coins, table to tops, bottle caps, buttons, etc.)
paper shapes (various sizes)
1/4" wide strips
Judy Property Blocks
3-D Models (blocks)

Table 3 (continued)

Miscellaneous Arithmetic Aids

peg board & pegs or golf tees
flannel and/or magnetic board materials
plastic or sandpaper numerals
pocket chart & cards
set cards (incl. arrays and dozens)
equation cards (flash)
number & symbol cards
word cards
simple street map

General Classroom Supplies

flannel and/or magnetic board
squared paper
tracing paper
pail
wire coat hangers
heavy string
thumbtacks
rubberbands
yarn
lengths of ribbon or string
gummed circles
crayons
paste
scissors
book with square corners
table of contents with Roman Numerals

___________ Recommended by APH Math Institute for development
_ _ _ _ _ _ _ Recommended by Hilda Caton to supplement illustrations

Summary and Conclusions

This study has identified twelve general concept areas discovered in the analysis of five primary mathematics textbook series and ranked them according to their frequency of appearance. Such identification and ranking should aid in establishing deficit areas where materials for the visually impaired need to be developed.

The scope and sequence of each concept area has been presented in detail including vocabulary and suggested aids. This information has been prepared for use in setting specifications for materials development and for use in developing and evaluating instructional units for tangible aids.

The suggested aids for primary mathematics instruction were often found to overlap the general concept areas. The suggested aids under eight subheadings were compiled to provide an easy reference for the educational researcher responsible for development of tangible apparatus for the visually impaired on the primary level.

This study should be regarded as a preliminary step in the materials development process. It identifies concept areas which may pose deficits in learning for the visually impaired, identifies aids for deficit remediation, and suggests priorities and guidelines for materials development.

Task 7 Development of a geometric area and volume aid

Project Personnel Hilda Caton

Purpose

The Geometric Area and Volume Aids (GAVA) was developed as a result of a study related to the identification of tangible aids to be used in mathematics by visually handicapped children (Caton, 1969). The purpose of the study was to demonstrate a new approach to the identification of tangible aids for visually handicapped students. This approach was designated as textbook analysis and it can best be described as a research-oriented approach, based on a thorough review of the existing literature and a careful and systematic analysis of concepts which are conveyed to students by means of illustrative materials. The results of this analysis are then used as guidelines to assist in the identification and/or development of tangible aids which will convey the intended concepts to visually handicapped students.

In accordance with this purpose, the need for an aid such as the GAVA was identified and the aid was developed. In order to describe the procedure for developing the GAVA it is first necessary to briefly describe the textbook analysis procedure, which was as follows:

1. An extensive survey of existing literature was conducted in order to determine the present status of research in this area and to study methods of identifying aids which were used in the past.
2. A comparison of the illustrative materials in the braille and inkprint editions of Elementary School Mathematics (Eicholz & O'Daffer, 1964), grades one through six, was conducted in order to determine which illustrations had been omitted from the braille edition and which had been inadequately reproduced as raised-line illustrations.
3. A classification of the omitted and inadequately reproduced materials was made. The materials were classified as essential or non-essential, in terms of the actual need for the illustration in solving the problem.
4. Frequency tables were constructed in order to determine which illustrations appeared most frequently so that tangible aids needed to present the concepts they represented could receive first priority for development.
5. A search of current commercial catalogs was made and tangible aids which were available commercially were identified. Aids which were not available commercially were also identified and this information was used in setting priorities for development.

The frequency table and the list of aids which were needed but not available commercially were used to identify the need for the GAVA set of materials. A review of these analyses showed that there was a need for materials to teach the concepts of volume and surface area and also gave some indication as to the specifications for the materials. The procedure for the development and evaluation of the materials is presented in subsequent sections of this report.

Procedure

The first step in the actual development of the GAVA was to search the currently available commercial catalogs for materials which might be suitable for this purpose. The materials needed were sets of 1-inch square blocks, some of which were cut on the diagonal, which could be connected in some way to form the desired figures and then disconnected, at will, to form other figures. There were no sets of blocks of this size which contained blocks cut on the diagonal in the desired manner. However, there were some sets of 1-inch blocks available and sets of these blocks were purchased and modified to the desired shapes. Adaptations were made so that they could be connected and disconnected in the desired manner. In completed form, the set of blocks are wood with holes drilled in them which allow them to be connected with wooden pegs.

The specifications for the size and shape of the blocks were determined by examining the textbooks which contained lessons on finding volume and surface area. It was necessary to have materials which could be used to construct exact reproductions of the figures which were illustrated in the textbooks. This accounts for the need for blocks which were cut on the diagonal and for the size requirement of 1-inch square.

Materials description

The GAVA set of geometric blocks for finding volume and surface area consists of 30 unpainted, wooden blocks (10 different shapes), 20 connector pegs, and a wooden storage/carrying tray. With these blocks, it is possible to construct models of three-dimensional figures relating to surface area and volume which are most often found in elementary mathematics texts. The unit size of each block is 1 cubic inch. The complete GAVA set consists of a wooden tray divided into 11 sections, 6 single-unit blocks plus a 24 multiple-unit blocks, and 20 connector pegs. The multiple-unit blocks are made tactile by incised grooves which provide for easy unit discrimination. Each of the different blocks is assigned a code-letter identifier and is stored in the proper section of the wooden tray which carries the corresponding letter. Code-letter identifiers make it possible to construct various figures according to construction formulas. For example, the formula 2E would indicate that two blocks with the code-letter E should be used to construct the desired figure. The brochure which accompanies the GAVA gives illustrations of construction formulas for 36 commonly used fugures and some suggested activities for students. Construction of the figures is accomplished by inserting the connector pegs into holes in the blocks to hold them together. The student determines volume by counting the number of cubes in each solid and surface area by counting the number of sides he can touch on each form. These materials are pictured and described in a brochure contained in Appendix B.

Subjects

The GAVA set was field tested to evaluate its effectiveness when used by visually handicapped children. The textbook examination revealed that the introductory material for the concepts of volume and surface area were contained primarily in the third grade textbook, the bulk of the new material illustrating these concepts was presented in the fourth grade text, while the fifth and sixth grade books contained material which was basically a review of these concepts. For this reason, the students for the field test were chosen on the basis of their grade level as determined by their arithmetic achievement scores and I.Q., rather than by chronological age. It was felt that children with I.Q.'s in the normal range and arithmetic achievement scores at the third and fourth grade levels would be suitable. The subjects were all braille readers, since the aid was designed for their use rather than for children who are partially seeing. The number of subjects was somewhat limited because the study was conducted during the summer vacation period and many students were not available. Four subjects who were students at the Kentucky School for the Blind participated in the study. The following table contains data related to the subjects:

Table 1
Data on Subjects

				Arithmetic Achievement *		
Subject	Grade	Age	IQ	PROBLEM SOLVING	COMPUTATION	MEDIAN
Subject A	6	12	95	3.7	4.6	4.0
Subject B	8	15	104	3.9	5.4	5.3
Subject C	7	13	119	5.4	4.9	6.8
Subject D	8	13	119	3.3	5.4	4.0

*Stanford Achievement Test Scores

Results

The procedure used in the field test was that of a pretest, training, retest after training, and a posttest. In the pretest, students were simply asked to find the volume and surface area of specific raised-line figures and figures made from the GAVA. They were given no instruction regarding methods for doing this, except for an explanation that they were to use the 1-inch square block as a unit of measure. Their answers were given in terms of these "cube units" and not in terms of actual inches. They were required to use, first, the raised-line illustrations and then, the figures constructed from the set of GAVA blocks. They were not given the same figures in raised-line form and in block form. This was done to avoid the possibility that they would arrive at the answers using one method and simply give the same answer when using the other method. The pretest was given for two reasons. The first was to determine what information the students had regarding volume and surface area and the second was to judge the difference in their ability to read raised-line illustrations and to use the figures constructed from the GAVA set. Scores on the pretest are given in the table below:

Table 2
Results of Pretest for Volume and Surface Area

	Volume				Surface Area			
	Models		Illustrations		Models		Illustrations	
Subjects	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Student A	3	2	0	5	0	5	0	5
Student B	1	4	1	4	0	5	0	5
Student C	3	2	0	5	0	5	0	5
Student D	3	2	4	1	0	5	0	5
Total	10	10	5	15	0	20	0	20

Results of the pretest indicated that the students had some knowledge concerning volume, but practically no knowledge concerning surface area. All students had completed the fourth grade in which these concepts were taught. Therefore, their lack of knowledge was probably caused by the difficulty in understanding the figures involved rather than a lack of information about the concepts. Subjects had a great deal of difficulty in reading the raised-line drawings correctly and were not able to distinguish the figures concerned with surface area at all. This seemed to be due to the fact that they were required to distinguish the sides of the raised-line illustrations when finding surface area and this dimension is not clear in raised-line drawings.

Following the pretest, subjects were given instructions in the use of the GAVA set in finding volume and surface area. Then, they were retested on the same items used in the pretest. They were not informed that the items were the same, however. The results of the retest showed some improvement in the ability to find volume and surface area on both the diagrams and the GAVA set. The improvement might have been partially due to the fact that the subjects recognized the figures, although they gave no indication that they did. Scores on the retest are given in Table 3 below:

Table 3
Results of Retesting after Instruction for Volume and Surface Area

	Volume				Surface Area			
	Models		Illustrations		Models		Illustrations	
Subjects	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Student A	3	2	3	2	2	3	0	5
Student B	3	2	1	4	0	5	0	5
Student C	5	0	0	5	2	3	0	5
Student D	5	0	4	1	3	2	3	2
Total	16	4	8	12	7	13	3	17

The final step in the evaluation was to administer a posttest which was composed of 20 entirely new models and illustrations. The number of items in the posttest was increased in order to give students more opportunity to demonstrate their knowledge of the concepts tested. Scores on the posttest are given in Table 4 below:

Table 4
Results of Posttest for Volume and Surface Area

	Volume				Surface Area			
	Models		Illustrations		Models		Illustrations	
Subjects	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
Student A	9	1	0	10	4	6	0	10
Student B	5	5	1	9	1	9	0	10
Student C	7	3	0	10	5	5	0	10
Student D	7	3	4	6	9	1	2	8
Total	28	12	5	35	19	21	2	38

Results of the posttest showed a definite increase in subject's abilities to find volume and surface area when using the GAVA set, and some increase in their ability to read the raised-line drawings. This indicates that the subject's performance when using the GAVA set were definitely superior to their performance when using raised-line illustrations of the same figures. The fact that the performance on the retest after instruction was slightly higher than that on the final test can probably be accounted for by the fact that students had previously worked with the figures which were used on retest, while the figures used on the final test were entirely unknown to them.

The scores on surface area tests were consistently lower than those on volume tests. The discrepancy in the scores probably occurred because the whole blocks used in finding volume were much more easily distinguished tactually than the sides of the blocks, which were used to find surface area. However, the scores on surface area were slightly higher when the students used models constructed from the GAVA than when raised-line illustrations were used. Scores on all tests in which subjects used raised-line drawings were very low and subjects' reactions to the drawings were extremely negative. They experienced difficulty in locating the sides and tops of three-dimensional drawings and in reading illustrations which required knowledge of depth perception or perspective.

Concluding Statement

The field test of the GAVA set indicated that students definitely perform problems related to volume and surface area more easily and more accurately when provided with a tangible aid designed for that purpose. Further, an inspection of the scores on such problems when raised-line illustrations are used seems to indicate that such illustrations are not appropriate for teaching the concepts of volume and surface area. In addition, the reactions of the subjects to the raised-line illustrations was extremely negative while their reactions to the GAVA set was extremely positive and enthusiastic. This, plus the fact that scores on all tests in which the GAVA set were used were higher than when they were not used, indicates that this aid will be of value to visually handicapped students.

Task 8 Development of a number line for primary visually impaired students

Project Personnel Eleanor Pester

Purpose

Inadequate arithmetic achievement by visually impaired children often results from a lack of meaningful, basic numerical experiences (Riddle, 1948). Some special aids for the visually impaired are needed to remedy this situation. Modern mathematics programs for the sighted in the primary grades rely heavily on the number line for presenting new concepts and building understanding. A suitable number line for visually impaired children should have the same potential for teaching number concepts as the number line appears to have for sighted children. The purpose of this study was to determine the requirements for a primary number line, to develop a suitable number line for use by primary visually impaired students, and to evaluate their performance using this device.

Procedure

Through recommendations of a mathematics consumer panel and analyses of textbooks, it was determined that a suitable number line for visually impaired children did not exist and the following criteria for development were established:

1. It should be versatile so that it could be used with a number of different line segments to develop a variety of concepts in all of the primary grades.
2. It should be manipulative so that a child could learn mathematical relationships by demonstrating them on a number line for himself.
3. It should be simple so that a visually impaired child could use it tactually without unnecessary confusion.
4. It should be practical so that it would fit on a desk and be lightweight and sturdy.

Since no commercially available number lines were found to be completely suitable for primary visually impaired students, a number line device was developed to meet the requirements, incorporating as much flexibility as possible into the device.

The number line device appeared to be quite useful and to satisfy the established criteria. However, it was only through formal evaluation and observations of the device in use with primary visually impaired children that such expectations could truly be realized. Therefore, formal evaluation was planned to observe and to test the number line device in a classroom setting. The following preliminary criterion of acceptability was established:

Legally blind children enrolled in the primary grades would be able to work correctly at least 50 percent of the test problems in the first four sessions following brief instructional sessions on the number line.

The following null hypotheses were tested:

1. There would be no significant difference between the scores of children using a tactual mode and those using a visual-tactual mode to work these test problems in the first four sessions on the number line.
2. There would be no significant difference between the scores of children using the peg method and those using the bar method to work these problems on the number line.
3. There would be no significant difference between the scores of children changing from the peg method to the bar method and those changing from the bar method to the peg method to work the problems in the final (fifth) session on the number line.

In order to observe and test the performance of primary visually impaired children using this device in a classroom situation, an instructional/evaluation unit was devised by the investigator. It was designed to measure performance on the device, limited to concepts related to addition and the segments 0-20 by ones and 0-200 by tens.

The unit covered primary addition concepts sequentially in four sessions of increasing levels of difficulty based on textbook analysis (Task 6) and research (Merry, 1930). Each line segment was introduced separately in a lesson before the two segments were presented together. Addition of rounded off numbers, which was usually not covered in the primary level according to textbook analysis, was given for enrichment and as a challenge for the students who might have already studied some of the other concepts before being introduced to the number line device. The fifth session introduced an alternate method for working problems on the number line and reviewed all of the concepts developed in the first four sessions.

Each session assumed the general pattern of instruction followed by testing. A brief discussion session with oral questions and answers were used to introduce the lessons. Practice problems of the same difficulty and type as those on the test were given. The discovery method was used whenever possible to help the students progress from one concept to another. Each session ended with several test problems.

In scoring the test, emphasis was on performance on the number line device. One point was awarded for demonstrating the correct answer by the prescribed method (operational score) and another, for pointing to the correct answer on the line segment (reading score) for a maximum of two points for each problem. If the work was incorrect, no points were awarded.

Since it was felt that observations, particularly of difficulties children encountered in using the device, might have just as many implications for the further development and use of the device as the children's test scores themselves, an effort was made to find a method of recording such observations quickly and accurately while working with a small group of students. The result was a simple key for most types of errors the children made. By using this key, the investigator could make a frequency count of the types of errors.

Two pilot studies were conducted to get early feedback on both the number line device and the instructional/evaluation unit.

Although statistical analysis of the data was originally planned, upon arrival at the test school it was discovered that there were fewer subjects than had been anticipated and that some did not conform to the classifications. Because time and cost factors did not warrant further evaluation at other schools, the groups of subjects were small and unequal and did not generally permit statistical analyses. Therefore, descriptive results were limited for the most part to trends indicated by the data.

Materials description

The number line device consists of three parts - a blue plastic base, ten interchangeable vinyl line segments, and forty plastic cylinders which serve as pegs and/or interlocking bars.

The plastic base, 24 1/4" x 6 1/2" x 1 3/4", houses one or two of the vinyl line segments at a time. The segments are fastened securely to the base over a peg located at each end of the base. On the base behind each line segment is a horizontal groove with holes at intervals. This horizontal groove corresponds to the line on the segment while the holes represent the points. At the front of the plastic base is a tray area with two parts. The tray area is used for storage and work with the plastic cylinders.

Each vinyl line segment, 20 3/4" x 1 1/2", is white with a black raised line running the length of the strip. Large raised black dots are located at intervals on the raised line and indicate the position of the braille and print numerals on the segment. (Braille number signs have been eliminated on all segments to facilitate reading and placement of the numbers on the strip). The following line segments marked horizontally, are included:

(1) 0 - 20 by ones
(2) 0 -200 by tens
(3) 0 -100 by fives
(4) -10 - +10 by ones

(5) Halves)
(6) Thirds)
) Equivalent (One whole equals one foot.)
(7) Fourths)
(8) Sixths)
(9) Fractional tenths)
) Equivalent (One whole equals ten inches.)
(10) Decimal tenths)

The forty white plastic cylinders, 1" x 1/4", are used to show numerical relationships on the number line segments. They are hollow on one end with a corresponding projected tip on the other end. The tip and the opening enable the cylinders to be interlocked. When they are interlocked and placed horizontally in the base groove, the cylinders are called bars. Bars represent the segments on the number lines. When the cylinders are placed individually and vertically in the base holes, they are called pegs: The pegs represent the points on the number lines. These materials are pictured and described in a brochure included in Appendix B.

Subjects

Subjects for the formal evaluation were twenty-six legally blind students, ages six to ten, enrolled in the first, second, and third grades at Overbrook School for the Blind in Philadelphia, Pennsylvania. Half of the subjects participating in the evaluation used the peg method for the first four sessions and changed to the bar method for the last session; half of the subjects used the bar method for the first four sessions and changed to the peg method for the last session. The students were categorized for evaluation purposes as using a tactual mode or a visual/tactual mode through observation by the investigator during testing. A maximum of five students was included in each group tested. Each student was given his own number line to use during the sessions. The unit was completed in five days with sessions of approximately one hour each per group.

Results

The results were as follows:

1. Subjects worked an acceptable number (58.70 percent for sessions I-IV combined and 59.82 percent for session V) of the test problems correctly.
2. A t-test for independent groups indicated that correct performance of subjects using a visual/tactual mode was significantly better than those using a tactual mode ($t = 2.193 \; p < .05$).
3. Although a t-test showed that the difference between the peg and bar methods for correct performance were too small to be significant, they did indicate trends toward the superiority of bars over pegs for the tactual group and the superiority of pegs over bars for the visual/tactual group. These trends were substantiated by the patterns of errors made in each group.

4. Although t-tests indicated that the differences in order of presentation were too small to be significant, they did suggest an order effect for the tactual group such that bars followed by pegs were better, and an order effect for the visual/tactual groups such that pegs followed by bars were better.

5. Subjects did not increase or decrease their scores significantly when they were introduced to a new method of operation. Patterns of errors with bars and pegs remained the same for the tactual group but were eliminated in the visual/tactual group because of the practice effect.

Conclusion and Implications

From the analysis of the data, the following conclusions can be drawn:

1. Primary visually impaired children could perform an acceptable number of problems on the number line device after very brief instruction. Therefore, this device should be accepted as a suitable mathematical aid for primary visually impaired children.
2. The performance of students with some useable vision was significantly superior to those using only the tactual mode. Therefore, teachers should treat these groups separately, allowing more instruction and practice time for the tactual group.
3. Although the differences were not significant, trends indicated that bars were superior for those using the tactual mode while pegs were superior for those using the visual/tactual mode. Therefore, initial instruction for the tactual group should be with bars while the visual/tactual group should use pegs.
4. Although the differences were not significant, trends indicated that bars followed by pegs were better for the tactual group and pegs followed by bars were better for the visual/tactual group. Therefore, instruction on the number line for the tactual group should begin with bars and later switch to pegs and for the visual/tactual group, should begin with pegs and later switch to bars.
5. Children tend to perform in the same general way using either bars or pegs. However, patterns of errors seem to be closely associated with the method of operation and the difference in the amount of practice required for the tactual and visual/tactual groups.

Task 9 Geometric forms for young blind students

Project Personnel Frank Franks and Roger Huff

Purpose

The purpose of this pilot evaluation was to verify that primary grade visually handicapped students could identify the shapes of the simple geometric forms of triangle, square, and circle when represented as curves, tangible plane figures, and three-dimensional shapes. The instructional program used to introduce the shapes to visually handicapped students was drawn from tasks appearing in the primary grade curriculum in mathematics which used the above geometric forms.

The instructional program was divided into three levels roughly corresponding to grades one through three. The concepts presented at each level were identified in a curriculum analysis described in Task 4. Each level of the instructional program introduced the shapes of circle, square, and triangle in a different dimension (i.e., Level I-curves, Level II-planes, Level III-three dimensional figures).

Procedure

Subjects were tested individually and each level of the instructional program was completed before the student proceeded to questions in the next level. As each level of the instructional program was read to the subjects, materials were manipulated and tasks were performed in the identification of the shapes.

Four subjects were tested at the first grade level but only two of the subjects were able to complete all levels of the instructional program. The second and third grade students completed all three levels of the instructional program.

A minimum of three low vision subjects from grades I, II, and III at the Tennessee School for the Blind were selected to participate in the pilot evaluation. One additional subject was added for a total of ten subjects.

Materials

The materials consisted of thermoform raised line figures on plastic sheets; of tangible plane figures of circle, square, and triangle; and of three-dimensional solids of a sphere, a cube, and a pyramid. All shapes roughly correspond to a two inch configuration.

Results

Performance scores were computed based on the percent of questions answered correctly at each level of the instructional program. These data are presented in Table 1.

Table 1

Performance Scores on Percent* of Questions Correctly Answered

Subjects	Level I-31 Questions		Level II-21 Questions		Level III-9 Questions		Total % Correct combining three levels
Grade 1	Correct	%Correct	Correct	%Correct	Correct	%Correct	
1	29	94	21	100	8	89	95%
2	31	100					51%
3	26	84					43%
4	24	77	12	57	—	—	59%
Total	110	89%	33	39%	8	25%	
Grade 2							
5	31	100	21	100	9	100	100%
6	30	97	21	100	8	89	97%
7	31	100	21	100	9	100	100%
Total	92	99%	63	100%	26	96%	
Grade 3							
8	30	96	21	100	9	100	98%
9	28	90	21	100	8	89	93%
10	31	100	21	100	7	78	97%
Total	89	96%	63	100%	24	89%	

*Percents rounded

Results of the evaluation indicated that subjects tested at the first grade level successfully answered questions presented in Level I of the instructional program (89% correct response). Levels II and III were omitted at the first grade since all subjects did not finish all levels of the instructional program. Subjects at the second and third grade successfully answered the questions presented at all three levels of the instructional program (Grade II 99%, 100%, 96% respectively, Grade III 96%, 100%, 89% respectively).

Summary

The pilot evaluation verified that the primary grade visually handicapped students tested could identify the shapes of the simple geometric forms of triangle, square, and circle when represented as curves, tangible plane figures, and three-dimensional solids.

Subsequent to this pilot evaluation, the instructional program was revised and several slight modifications of the materials were made. These materials are pictured and described in a brochure included in Appendix B.

Task 10 Development of a large abacus

Project Personnel Roger Huff

Purpose

The need for a large abacus was defined in a recommendation from the consumer panel on materials development in mathematics (Task 5). These educators recommended the design of an abacus one-third larger than the Cranmer abacus. The large abacus was suggested for use by young visually handicapped students and those who lack the manipulative skill required for easy manipulation of the smaller device. It was also noted that the large abacus may be beneficial to the adult blind who have difficulty with manipulation and tactile discrimination.

Introducing a large abacus at the primary level may act as a catalyst to promote increased computational activity with the abacus at earlier levels in the education of the visually handicapped. Lewis (1970) has noted a trend in providing initial instruction with the Cranmer abacus at the third grade level. Introducing a large abacus may assist a portion of the visually handicapped population in performing mathematical computational tasks at even earlier grade levels. It was the purpose of this project to develop and evaluate a large abacus.

Procedure

An evaluation instrument was developed in the form of a teacher questionnaire which requested responses regarding the instructional effectiveness of the large abacus, urged suggestions for improvement of the design of the prototype, and asked each educator to indicate if there was sufficient need to warrant production of an enlarged device. Prototypes of the device along with copies of the questionnaire were distributed to eight residential and public school programs and three rehabilitation facilities located throughout the country. Particular attention was given to exposing the large abacus to young visually handicapped students and those with additional involvements who might experience difficulty using the Cranmer abacus. Mathematics teachers were asked to use the device with their students and record their reactions to instructional sessions. The field evaluation was conducted over a period of six months but the majority of instructional programs completed the evaluation within a period of four to six weeks.

Materials

A prototype of a large abacus was constructed similar in design to the Cranmer abacus. The enlarged device measured approximately 4 3/8 inches x 8 inches with thirteen columns of one-half inch beads. Unit markings on the enlarged prototype were identical to the Cranmer device. This device is pictured and described in a brochure included in Appendix B.

Results

A total of 31 responses representing 11 educational programs were received. Table 1 shows the approximate percentage of responses which indicate the reaction of teachers to the usefulness of the large abacus as an instructional tool. A majority of the teachers felt that the large abacus was an effective instructional device and recommended that it be produced by the American Printing House for the Blind.

Table 1
Teacher Response to Instructional Effectiveness
of Enlarged Abacus in Percents*

Types of Classes Participating in Evaluation	Number of Teacher Responses	Positive	Neutral	Negative
Multihandicapped	3	33%	33%	33%
Primary (K-2)	5	100%	-	-
Intermediate (3-5)	8	100%	-	-
Jr. High (6-8)	6	67%	33%	-
High School	4	75%	25%	-
Adults	5	100%	-	-
Total	31	84%	13%	3%

*Percents rounded

In addition to specific information related to the instructional effectiveness of the device, mathematics teachers provided general comments relevant to its use. Teachers indicated that the visually handicapped students who would benefit from using the device would be those with fine motor coordination problems, orthopedic handicaps, and low vision. The majority of teachers indicated the enlarged device would be beneficial at the primary level and could be used as an introductory aid for the Cranmer abacus, facilitating transition to the smaller device because of the similarity in design. Several responses acknowledged that the enlarged device would be beneficial in teaching the fundamentals of abacus manipulation by training hand coordination using the larger device. Simultaneous instruction of groups using both the large and the Cranmer device is possible. Teachers felt the advantages of the device are inherent in the larger beads, frame, and spaces between columns. They felt that students could easily distinguish and manipulate the beads and were provided ample room for resting hands on the device. One response indicated that more accurate work was produced by several students who used the device.

Several disadvantages were also noted by teachers. Visually handicapped students felt the larger device would not be as easy to carry as the Cranmer abacus. Slower work was produced by some, possibly a novelty effect was contributing to this factor. One response indicated students with perceptual problems had difficulty in distinguishing the rows of beads because of the similarity in shape and color.

Suggestions for changes in the device included rubber edges to withstand abuse and to prevent sliding on table tops, stronger beads, beads of different shapes and colors for easier visual perception, and providing enough tension on beads to prevent unwanted slippage.

Summary

Mathematics educators of the visually handicapped recommended the development of an abacus one third larger than the Cranmer abacus. The suggested target population that would use the enlarged abacus are young visually handicapped students, those with additional involvements, and adults experiencing manipulation and discrimination problems. An evaluation was conducted which indicated that the majority of teachers who participated felt the enlarged abacus was a useful computational device and should be produced by the American Printing House for the Blind.

Task 11 Fractional parts of wholes

Project Personnel Roger Huff and Frank Franks

Purpose

The earlier introduction of basic concepts and operations in the elementary mathematics curriculum emphasizes the need for specialized educational aids for introducing conceptual operations very early to young visually handicapped students. The need for specialized aids was emphasized by the consumer panel for mathematical materials (Task 5) and is supported by a series of in-depth analyses of elementary textbooks (Caton, 1969, and Tasks 3, 4 and 6).

The purpose of this project was the development of an educational aid to introduce fractional parts of wholes to young blind students. The components of the aid are fractional representations which can be examined and manipulated tactually and can be used to perform operations which show concretely the relationship of fractional parts to each other and to the whole.

Procedure

Each subject participated in a series of trials involving manipulation and discrimination tasks. Each subject was tested individually. A screen through which the subject placed his hands was used to occlude vision. The manipulation tasks preceded the discrimination tasks.

Each subject was given three practice trials in the manipulation phase of the evaluation. These trials introduced the subject to the nesting task using a whole circle and a single nest. The subject examined the whole circle and the nest and was asked to place the whole circle in the nest. The subject was allowed to ask questions regarding any phase of the task he did not understand. Following the practice trials, a series of nine manipulation tasks were presented to each subject which consisted of placing the rubber fractional parts (located in the storage boxes at the bottom of the work tray) in the nests. The manipulation tasks required the subject to correctly place the parts of the circles in the nests with the curved side of each part against the curved side of the nest. All combinations of parts had to be fitted adjacent to each other in the nest. When a subject had difficulty with a manipulation task, the experimenter demonstrated the correct nesting procedure. The subject then repeated the manipulation task by himself. Each subject was allowed six trials to complete each task. If after six trials the subject was unable to correctly perform the task, the response was recorded as incorrect.

The criteria accepted for the manipulation phase of the evaluation was that 75% of all the subjects within each grade level would perform all of the manipulation tasks correctly within the six trials permitted.

Following the manipulation phase the subjects were introduced to the discrimination tasks. Twenty-one discrimination tasks were presented to each subject in the discrimination phase of the evaluation. Each subject was given four practice trials before receiving the experimental trials. The practice trials consisted of SAME/DIFFERENT and WHICH IS THE LARGEST PART responses to each of the following paired comparisons:

Left form board nest	Right form board nest	Answers
a) whole circle	-1/2 circle	-Different Sizes
b) whole circle	-whole circle	-Same Size
c) 1/2 circle	-whole circle	-Different Size
d) 1/2 circle	-1/2 circle	-Same Size

If after four practice trials the subject did not understand the relationships of SAME/DIFFERENT and WHICH IS THE LARGEST PART, the subject was dropped from this phase of the evaluation.

Fifteen of the 21 tasks incorporated a second discrimination task. Each subject was asked to determine if the fractional parts they were examining were the SAME SIZE or DIFFERENT SIZES. If the subject answered DIFFERENT SIZES then the experimenter would ask WHICH IS THE LARGEST PART? Answers were recorded to the second task only if the subject correctly performed the first discrimination.

During the experimental trials, the experimenter placed the whole circles and parts of circles in the nests. Parts of circles were placed so that the empty portion of the nest was always above the nested part.

Each grade level was divided into two groups. Half of the subjects from each grade level were presented with one random order of the discrimination tasks while the other half were presented with a different random order of the discrimination tasks.

In evaluating whether subjects could discriminate size differences and the larger of two sizes, lower confidence limits were computed to establish a criteria for minimal performance. Using $p = .05$ for 21 trials of the SAME/DIFFERENT discriminations, the lower confidence limit required was 68%. Using $p = .05$ for 15 trials of the WHICH IS THE LARGEST PART discriminations, the lower confidence limit required was 71%. The average correct discriminations then for subjects as a group within each grade level for each trial would have to be 68% for the SAME/DIFFERENT discriminations and 71% for the WHICH IS THE LARGEST PART discriminations in order to demonstrate above chance performance.

Materials

The Fractional Parts of Wholes aid consists of a wooden work tray, three styrene plastic form boards containing one, two, and three empty nests respectively, one whole rubber circle, and the following fractional parts: one rubber circle cut into halves, one rubber circle cut into thirds, and one rubber circle cut into fourths. A whole circle is three inches in diameter, nine-sixteenths of an inch thick and rises three-eights of an inch above the form board nests in which the rubber materials are placed.

For purposes of conducting the evaluation three extra parts (one 1/3 part, two 1/4 parts) were added to the kit.

These materials are pictured and described in a brochure included in Appendix B.

Subjects

Thirty-two students classified as braille readers or potential braille readers participated in the study. Three students were dropped because they did not understand the tasks to be performed in the evaluation. Nine subjects were classified as beginners, and 10 subjects were classified as first and second graders. The means and standard deviations for the ages are as follows: Beginners' $\overline{x}$ age = 6.6, SD = .50; First Grade $\overline{x}$ age = 8.1, SD = 0.1; Second Grade $\overline{x}$ age = 8.6, SD = 1.07. Subjects were from the Governor Morehead School for the Blind (North Carolina), the Kentucky School for the Blind, and the Tennessee School for the Blind.

Results

The data were analyzed in terms of two measures of performance: (a) the mean number of manipulation trials to complete the manipulation tasks for subjects as a group within each grade level, and (b) the percentage of correct responses for each class of discriminating tasks for subjects as a group within each grade level.

All of the subjects performed all of the manipulation tasks within a six trial criterion established prior to evaluation. Analysis of variance was performed on these data and significant differences were found between grade levels for the number of trials necessary to reach criterion on the manipulation tasks ($F = 7.89$; $df = 2/26$; $p < .01$). See Table 1 for summary of the analysis of variance.

Table 1

Analysis of Variance on Mean Number of Manipulation Trials for Differences Between Grade Levels

Source	df	SS	MS	F
Total	28	2.9809	.1064	
Grades (K, 1, 2)	2	1.1305	.5652	7.89*
Error	26	1.8633	.0716	

*p < .01

In the discrimination phase of the evaluation two random orders were employed in presenting each class of the discrimination tasks (SAME/DIFFERENT - WHICH IS THE LARGEST PART). These data were treated with *t* tests to determine if there were any significant differences between the random orders of presentation of each class of discriminations. Results of the tests indicated no significant differences between orders used in either class (SAME/DIFFERENT, $t = 1.51$, df = 27, $p > .10$; WHICH IS THE LARGEST PART, $t = 1.30$, df = 27, $p > .20$). Both orders in each class were combined to determine the overall degree of accuracy for each class of discrimination tasks.

The percentage of correct responses for each grade level and for grade levels combined on each class of discrimination tasks were computed. These data indicated that of the 21 SAME/DIFFERENT discrimination tasks presented, beginners correctly identified 15 discriminations, first graders correctly identified 18 discriminations, and second graders correctly identified 19 discriminations at the above chance level of performance (68%). Fifteen WHICH IS THE LARGEST PART discrimination tasks were presented and beginners correctly identified 10 discriminations, first graders correctly identified 12 discriminations, and second graders correctly identified 12 discriminations at the above chance level of performance (71%). The performance on the discrimination phase of the evaluation indicates that subjects as a group within each grade level failed to discriminate the size difference between one-third and one-fourth above chance level. Beginners as a group had more difficulty than first or second graders in discriminating size differences between thirds and fourths at above chance levels of performance.

The discrimination data were treated with an analysis of variance to determine whether there were significant difference in performance between grades for each class of discrimination tasks. The mean scores for the first class of discrimination tasks (SAME/DIFFERENT) increased over the grade levels: Beginners', $\overline{x}$ Score = 17.55, SD = 1.31; First Grade, $\overline{x}$ Score = 18.50, SD = 1.08; Second Grade, $\overline{x}$ Score = 19.20; SD = .78. Analysis of variance of these data revealed there were significant differences between grade levels ($F = 6.49$; df = 2/26; $p < .01$). *Post hoc* comparisons were performed on these data to determine which differences between grade levels were significant. The performance between beginners and first graders, beginners and second graders, and first and second graders were compared and a significant difference occurred only between beginners and second graders (Tukey's HSD test; HSD = 5.07; df = 2/26; $p < .01$, [Kirk, 1969]). See Table 2 for a summary of the analysis of variance.

Table 2

Analysis of Variance on Total Number of Correct Same/Different Discriminations for Differences Between Grade Levels

Source	df	SS	MS	F
Total	28	39.1724	1.3990	
Grades	2	13.1342	6.5670	6.49*
Error	26	26.3222	1.0123	

*p < .01

The mean scores for the second class of discrimination tasks (WHICH IS THE LARGEST PART) increased between the beginners and first grade only: Beginners', $\overline{x}$ Score = 12.22, SD = 1.85; First Grade, $\overline{x}$ Score = 13.30, SD = .82; Second Grade, $\overline{x}$ Score = 13.30, SD = .82. The analysis of variance of the data on the second discrimination task yielded no significant differences between grade levels on performance ($F = 2.44$, $df = 2/26$; $p > .05$).

Summary

The results of this study indicate that primary level (K through 2) visually handicapped students can successfully manipulate the Fractional Parts of Wholes aid and discriminate a majority of the fractional comparisons presented in the evaluation. However, all students encountered difficulty in discriminating size differences between the fractional parts of one-third and one-fourth.

The manipulation phase of the evaluation revealed that primary students required fewer trials to nest the fractional parts in the form boards as grade levels increased. This measure of performance supports the conclusion that primary visually handicapped students should not experience difficulty in manipulating the component parts of the aid.

The discrimination phase of the evaluation indicated that beginners as a group had more difficulty than first or second graders in discriminating at above chance levels of performance the fractional comparisons presented in the evaluation.

Further research is needed to determine if primary level tactual learners can successfully discriminate thirds from fourths after they have completed a preliminary series of training exercises. Subsequent investigations could focus on determining thresholds for relative fractional size discrimination.

Task 12 Tactual ruler familiarization instructional unit

Project Personnel Frank Franks and Roger Huff

Purpose

The purposes of the evaluation were to determine the ability of primary grade visually handicapped braille readers to discriminate tactile symbols embossed on the APH tactile ruler and to teach and evaluate their concepts of "inch" and "centimeter".

Data from analyses of mathematics textbooks (Caton, 1969; Task 5) identified measurement in mathematics as a problem area for visually handicapped children and as an area which required materials specifically designed for blind children. For these reasons, a tactile ruler with scales in both inches and centimeters was developed as an aid for teaching the concepts of linear measurement to these students.

Procedure

The evaluation procedure followed is outlined below.

1. The instructional unit was presented at each level. Concepts were introduced through the use of the thermoformed sections of the tactile ruler.
2. Following instruction, a posttest was administered at each level. The tactile ruler was used for testing purposes.

The basic goals and concepts presented at each level were as follows:

Level I -- Inches

Goal

To teach the tactual symbols on the inch scale of the tactile ruler

Basic concepts

1. The inch is a common unit of measurement.
2. An inch can be divided into two equal parts called half-inch and one-inch lines.
3. Each half-inch on the ruler is marked or shown by a short raised line; each one-inch then is shown by a long raised line.

Level II -- Centimeters

Goal

To introduce the concepts of the metric system on a tactile ruler

Basic concepts

1. The centimeter is a unit of measurement.
2. A centimeter is divided into two equal parts called half-centimeters and one centimeter lines.
3. Each one-half centimeter is marked or shown by a short raised line and each whole centimeter is shown by a long raised line.

Specifically, the students were asked to perform the following operations:

1. Count all the inch lines (e.g. half-inch and one-inch lines).
2. Count all the half-inch lines.
3. Count all the one-inch lines.
4. Count all the centimeter lines (e.g. half-centimeter and one-centimeter lines).
5. Count all the half-centimeter lines.
6. Count all the one-centimeter lines.
7. Convert from half-centimeter lines to half-inch lines.
8. Convert from half-centimeter lines to one-inch lines.
9. Convert from one-centimeter lines to half-inch lines.
10. Convert from one-centimeter lines to one-inch lines.
11. Convert from one-inch lines to half-centimeter lines.
12. Convert from half-inch lines to one-centimeter lines.
13. Convert from one-inch lines to one-centimeter lines.
14. Convert from half-inch lines to half-centimeter lines.

Materials

The tactile ruler familiarization unit consists of three vacuum-formed plastic sheets 6 1/2" x 14" illustrating English, Metric, and English-Metric measurement units.

On Sheet 1 there are two ruler segments, each mounted on a raised base which is twelve inches in length. The first illustration is a one-inch ruler segment which has a short raised line representing a half-inch measurement unit and a long raised line representing a one-inch measurement unit. The second illustration is a six-inch ruler segment which has six short raised lines representing half-inch measurement units and six long raised lines representing one-inch measurement units.

On Sheet 2 there are two ruler segments, each mounted on a raised base which is ten centimeters in length. The first illustration is a one-centimeter ruler segment having a short raised line representing a half-centimeter measurement unit and a long raised line representing a one-centimeter measurement unit. The second illustration is a five centimeter ruler segment having six short raised lines representing half-centimeter measurement units and six long raised lines representing one-centimeter measurement units.

On Sheet 3 there is a ruler segment and a 12-inch ruler, each illustrating English-Metric measurement units. The first illustration is a ruler segment with raised short and long lines designating half-centimeter and one-centimeter measurement units on the far edge of the ruler segment and half-inch and one-inch measurement units on the near edge of the ruler segment. The second illustration is a 12-inch ruler with raised short and long lines designating half-centimeter and one-centimeter measurement units on the far edge of the ruler and half-inch and one-inch measurement units on the near edge of the ruler. These materials are pictured and described in a brochure included in Appendix B.

Subjects

Thirty-seven legally blind students (18 males, 19 females) enrolled in two residential schools for the blind in grades 2, 3, and 4 were used for evaluation of the tactile ruler. Students with useful residual vision were tested using blindfolds. The age range of these students was 7 to 13 years.

Results

Subjects were required to perform tasks consisting of the identification of specific points on the tactile ruler. They were not required to perform measurement operations or tasks involving the comparison of the two measurement systems. A criterion of the successful completion of eighty percent of the test items at each level was considered indicative of the subject's ability to use the tactile ruler to perform the required tasks.

The number and percentage of blind students (tactile learners) who were able to correctly count inch lines and centimeter lines are reported in Table 1.

Table 1
Number and Percentage* of Correct Counting Responses

Counting	Number Correct Responses (N=37)	Percentage Correct Responses
All inch lines	36	97%
Half-inch lines	36	97%
Inch lines	36	97%
All centimeter lines	31	84%
Half-centimeter lines	37	100%
Centimeter lines	36	97%

*Percents rounded

Ninety-seven percent of the students correctly counted all the inch lines (e.g. half-inch and one-inch lines). Eighty-four percent of the students were able to count correctly all the centimeter lines (e.g. half-centimeter and one-centimeter lines). All the students correctly counted the one-centimeter lines, and ninety-seven percent correctly counted half-inch lines, one-inch lines, and half-centimeter lines. The six counting items met the predetermined level of acceptability (80% correct response).

Table 2 represents the number and percentage of blind students (tactile learners) who were able to convert from centimeter lines to inch lines.

Table 2
Number and Percentage* of Conversion from Centimeters to Inch

Conversion	Number Correct Responses (N=37)	Percentage Correct Responses
Half cm - half inch	33	89%
Half cm - inch	36	97%
CM - half inch	35	95%
CM - inch	36	97%

*Percents rounded

Eighty-nine percent of the students correctly converted a half-centimeter line to a half-inch line. Ninety-seven percent of the students correctly converted a half-centimeter line to a one-inch line. Ninety-five percent of the students correctly converted a one-centimeter line to a half-inch line. Ninety-seven percent of the students correctly converted a one-centimeter line to a one-inch line. Again all four conversions met the predetermined level of acceptability (80% correct responses).

In three of four items converting inches to centimeters the number of correct responses was below the level of acceptability. This information is reported in Table 3.

Table 3
Number and Percentage* of Conversion from Inch to Centimeter

Conversion	Number Correct Responses (N=37)	Percentage Correct Responses
Inch - half cm	22	59%
Half inch - cm	25	68%
Inch - cm	31	84%
Half inch - half cm	20	54%

*Percents rounded

Only in converting a one-inch line to a one-centimeter line was the percentage over eighty percent (84%). The three other items, converting a one-inch line to a half-centimeter line (59%), converting a half-inch line to a one-centimeter line (68%), and converting a half-inch line to a half-centimeter line (54%), were below the acceptable level.

Summary and Conclusions

The tactile ruler instructional unit was evaluated using 37 legally blind students. Tasks in counting inch and centimeter lines--which underlie the correct performance of measurement tasks--exceeded the criterion of 80% correct responses. Students also exceeded the criterion in converting from centimeters to inches. In converting from inches to centimeters students did experience some problems. Only in converting an inch line to a centimeter line was criterions performance attained. The three remaining conversions did not reach criterion performance. A number of students who expressed difficulty in locating centimeter lines stated that the lines were too close together.

A movable guide which slides along the ruler is attached to the APH tactile ruler and should minimize this problem for students who have been through the training program.

Since primary focus in linear measurement in grades 1-3 is on actual measurement tasks in inches or in centimeters as opposed to conversion, it is recommended that Levels I and II of the program and all tactile aids be used with young blind students to meet curriculum requirements. Conversion can be taught when students are developmentally ready to learn the process.

Task 13 Programmed abacus instruction

Project Personnel Suella McCrimmon

Purpose

Arithmetic computation has long been a problem for the blind. While no data are available for adults, results obtained by Nolan and Ashcroft (1969) and Nolan (1959) indicate that blind children suffer a significant deficit in this area. Performance of such children falls 16 to 20 percent below standards for the sighted. Part of this deficit may be ascribed to the crudity or cumbrousness of the computational techniques traditionally employed by the blind. In 1964, Nolan and Morris demonstrated at least a partial solution to these problems. Blind children trained over an eight month period in use of the Japanese abacus showed significant increases in computing speed and accuracy of computation for problems involving whole and decimal numbers.

The recent general adoption of the abacus as a computing device stresses the need for the development of instructional programs to train students in its use. The purpose of this project was to explore the feasibility of development of programmed instructional materials to solve this problem. The feasibility study was restricted to instruction in addition and subtraction.

Procedure

Initially, a set of specifications for the instructional program was drawn up. These specifications were reviewed by an advisory committee of three taken from the APH research staff. On the basis of this review the specifications were revised. A draft of the program for addition was completed. This draft was reviewed by the APH committee as well as by three classroom teachers with several years of abacus experience.

At this point in the development cycle, it became apparent that it was not feasible to provide a means of automatic feedback of adequacy of response to the student. Technical difficulty and expense prevented this. Subsequently, it was decided to continue to develop the program as a tutorial vehicle that could be used by a teacher with a few students at a time.

The addition program was revised and the subtraction program written. Both again were reviewed by the APH advisory committee and the three classroom teachers. Final revisions in the program were made following these reviews.

Finally, the tutorial version of the program was subjected to a field trial. An attempt was made to use the program with students in pairs. The program was presented daily over a ten week period. An effort was made to complete one lesson at each sitting.

Materials

The final program contained a total of forty-five lessons. Most lessons were divided into two or three sections. Each lesson contained from 12 to 24 frames with the mean number of frames per lesson being 19.37. Each lesson also contained a number of criterion items in which the student was expected to apply the skills taught in the instructional sequence. The content of the program is given in the following outline.

I. General orientation to the abacus.
II. Recording, clearing, reading and calculating directly with one and two-digit numbers.
III. Recording, clearing, reading and calculating directly with three-digit numbers.
IV. Recording, clearing, reading and calculating directly with four-digit numbers.
V. Addition rules
    A. Rules that require only downward motion of the index finger (1-4).
    B. Rule that requires clearing above the bar and setting one left (5).
    C. Rules that require clearing below the bar and setting one left (6-9).
    D. Rules that require clearing below the bar and clearing 5 before setting one left (1-4).
    E. Rules that require setting below the bar, clearing above the bar, and setting one left (6-9).
VI. Subtraction rules
    A. Rules that require setting below the bar and clearing above the bar (1-4).
    B. Rule that requires setting above the bar and clearing one left (5).
    C. Rules that require setting below the bar and clearing one left (6-9).
    D. Rules that require setting above and below the bar and clearing one left (1-4).
    E. Rules that require clearing below the bar, setting above the bar, and clearing one left (6-9).

Subjects

These were thirteen legally blind children enrolled in one elementary school and one high school in Birmingham, Alabama. They were, with one exception, enrolled in a regular school program and all of them were served by either a resource or itinerant teacher. Five of the students had had instruction in addition and subtraction on the abacus two years ago from a community volunteer but had not used the abacus since that time. The remainder of the students had never had any abacus instruction. Five were braille readers and the others used large print. The ages (8-17), intelligence quotients (54-111), and grade levels (3-11) of the students covered a wide range.

Results

Although all subjects except one started the program with a partner, no two subjects completed it simultaneously. Different rates of progress coupled with scheduling problems arising from absences for a variety of reasons soon reduced the instructional pattern to a one-to-one tutoring situation. This greatly increased the time necessary for instruction.

Five of the thirteen students who began the program were unable to complete it. The mean IQ of this group was one standard duration below normal. They were one year or more below grade level in arithmetic computation and arithmetic concepts.

The eight remaining students completed the program successfully. The group averaged 95% successful completion of frames and 95% successful computation of the criterion problems.

Sixteen of the forty-five lessons in the abacus program were acceptable. Each of the others contained either unacceptable frames (75% completion required) or sections that required revision.

Summary

An attempt was made to write programmed instruction to teach addition and subtraction on the abacus. This goal was blocked by inability to provide an automatic source of knowledge of results to the user. Subsequently, the material was tested in a small group tutorial situation. Small group use of the program failed to work. Test of the materials revealed that two-thirds of the lessons required some kind of revision. In view of these difficulties, work on this project was abandoned.

CHAPTER SEVEN

SOCIAL STUDIES MATERIALS DEVELOPMENT

The map study projects described in this chapter are part of a materials development program for teaching geographic readiness, geographical concepts, and map reading to primary and elementary grade students.

The blind student has a great need to attain concepts of the common features in his environment and his everyday world as they relate to a growing concept of himself. The sighted student observes real or pictured landscapes. The non-sighted student is dependent upon varying degrees of tactual interaction with his environment. This interaction is limited and provides the student at best with a very restricted view of his environment.

If young blind students are to gain the ability to interpret maps accurately, they first must observe and manipulate concrete objects in a known environment. The sighted student begins very early to develop a repertoire of geographical concepts based on concrete experiences in the home and school from which he constructs other more abstract concepts. Special efforts must be made with blind students to insure that features represented on maps are supported by concrete experiences. Each object or feature symbolized on a map must be conceptualized in terms of the feature itself if adequate interpretation is to be achieved.

The longer a child is without experiences which enable him to form accurate concepts of his environment, the harder it is for him to correct inaccurate concepts erroneously formed through incidental learning. The importance of readiness in map reading is to help the child to begin to observe and analyze the immediate world around him by providing structured learning experiences that can become the basis for comparing distant places to those with which he is familiar.

No appropriate education materials for introducing fundamental map reading concepts to young visually handicapped students were known to exist prior to initiation of this program. The following two-dimensional chart describes the program.

Grade K - 1	1 - 2	2 - 4
Experimental readiness	Landform models	Landform models
General geographic readiness concepts. Lesson guidelines.	20 geographic concepts are included, with Composite Map I.	40 geographic concepts, Composite Maps I and II.
Using the globe*	Using the globe*	Using the globe*
Although this is one module, the concepts introduced appear at all three levels.	Concept related activities using the globe at this level are used in conjunction with the	Concept related activities using the globe at this level are used in conjunction with the

	simplified continental relief maps: globe to map, map to globe.	simplified continental relief maps: globe to map, map to globe.
	Simplified continental relief maps--North America South America, Europe	Simplified continental relief maps* Asia, Africa, Australia
	This map is a tactile analog of a simplified visual relief map.	Additional continental relief maps are introduced.
Maps in the classroom and school environment*	Introduction to map reading I	Introduction to map reading II*
Orientation to the classroom and school are introduced concretely and then their components are presented abstractly using blocks, other subjects, and diagrams	Critical locational and directional referents, symbols, and simple relief are included; the real environment and symbological representation of natural and cultural features on maps are included in this module.	Introduction to map reading is expanded to include additional symbology and other characteristics of maps (e.g., scale-distance).
	ASSESSMENT	
	Geographical Concepts Information Test	Geographical Concepts Information Test
	This part of the test can be used to assess students' knowledge of 20 geographical concepts.	This test assesses students' knowledge or 40 common geographic concepts.
	Diagnostic Test: Locational and Directional Referents for Map Reading	Performance Test: Locational and Directional Referents for Map Reading
	This test is administered prior to teaching the referents.	This test is administered after the instructional program is presented to determine those concepts which require further remediation.

* To be initiated

Work was initiated in the program with a textbook analyses which explored the implications of lack of illustrations on learning by the blind. Next, visually impaired students' knowledge of common geographical terms was explored in two studies which resulted in development of a test for this purpose. Two subsequent studies concerned teaching basic concepts to students using landforms. At this time a consumer panel was convened to review efforts to date and to review plans for future activity. Following this, projects were initiated which developed materials to introduce map use to young students, to provide readiness guides to teachers, to develop simplified physical maps of continents, to teach students that known environments can be represented abstractly, and to develop recorded self-instructional materials to accompany the landforms developed early in the program.

Task I Illustrations in social studies textbooks as they affect the visually handicapped

Project Personnel Dharmasenna Arampatta

Purpose and Procedure

An analysis of illustrations (graphs, charts, maps, pictures) appearing in print and in braille social studies texts, including an analysis of illustrations omitted in braille texts, was made to provide a comparative picture of illustrative material in these texts. The results were broken down into tables which reflect the following specific purposes of the study:

1) To determine the frequency of distribution and the order of introduction of illustrations appearing in a popular print social studies textbooks series. (Tiegs - Adams [nine volumes]. Boston: Ginn & Co., 1960.)

2) To find the extent and variety of illustrations appearing in the braille editions of the series as published by the American Printing House for the Blind, Louisville, Kentucky.

3) To examine the extent of the discrepancies, if any, in the number and form of illustrations appearing in the print and braille editions.

4) To analyze the frequency and the order of introduction of illustrations in the print editions of the first three volumes in the social studies series written by Harold D. Drummond and published by Allyn and Bacon, Inc., 1969.

5) To study the nature of the language, concepts, and style of presentation in one volume of the Tiegs-Adams series--Stories about Sally--with a view to determine its compatability for transcribing into braille.

6) To study the nature and extent of important concepts relevant to social studies appearing in three print volumes of the above mentioned Drummond series and to see if and how they are illustrated.

7) To study the variety and extent of such formats in two volumes of the Tiegs-Adams series--Your World and Mine and Your Life as a Citizen--with a view to determine whether methodology should be devised to present such material to the visually handicapped.

Results

1) The authors of the two series of print textbooks examined appeared to follow an identical pattern in illustrating their material. Pictures, maps, charts, and graphs appeared in this order in the texts. Though there were few charts and diagrams in the earlier grades of books, both charts and graphs were more common in the advanced texts. Of the graphs, line graphs and histograms were the most frequently used.

2) Color was often introduced to add meaning or emphasis to the print illustrations.

3) While maps were more common than any other illustration in the embossed volumes, not all maps in the print editions or all data contained therein were represented to raised line maps. However, the total number of maps in the embossed volumes was a multiple of those in the print editions.

4) Picture maps, ground plans, and cross sections were relatively neglected in the embossed volumes.

5) Some of the graphs and charts in the print editions did not find their way into the embossed volumes; the few that went in were greatly modified.

6) The embossed volumes of the elementary grades suffered most in respect of illustrations. Consequently, the younger visually handicapped children appeared to miss most by using the embossed volumes.

7) Though a vast multitude of abstract concepts were introduced in the print editions, very few of them were illustrated in a tangible manner.

8) Some of the concepts, especially those pertaining to soils and minerals, did not appear to be amenable to two dimensional graphic representation.

9) The diagram was the popular mode of illustrating the majority of the concepts pertaining to climate, directions, and size and shape of earth in the Drummond series.

10) The role played by pictures in the print text was ambiguous. At most it was a peripheral role as they did not appear to belong to the core of the text.

11) The captions of pictures were often omitted in the embossed volumes. It needs to be probed whether a caption in its own right, without the picture, has a significant place in the text or whether it needs modification to provide the information that the missing picture depicts.

12) Much of the language contained in current textbooks is visually oriented. This is more true of the elementary textbooks than those of the higher grades. Whether this is the best language that suits the visually handicapped needs to be investigated.

13) Printers and publishers have devised various formats and techniques to present print material in the most effective manner. The embossed volumes invariably miss most of this format. It is opportune to examine ways and means of incorporating such devices in the embossed volumes.

Much intensive study of the problems of tactual graphics is called for. Tactual symbols have to be devised, legibility of different presentations of textures confirmed, and methodology of tactual presentation of graphic illustrations refined.

While further efforts to make the tactual map more legible are necessary, special attention is desired in the direction of devising the technology of tactual charts and graphs. Such techniques are vital as current social studies textbooks happen to include more and more charts, diagrams, and graphs which may have resulted from the expansion of the scope of social studies to cover areas traditionally confined to the fields of economics, political science, sociology, and anthropology.

The embossed elementary textbook devoid of graphic illustrations calls for immediate remedial action as it affects the young visually handicapped child adversely. Some tangible three-dimensional models and specimens to supplement the embossed text appear to be a solution which could be effected without much effort. Supplementary recorded aids could also be planned.

The visually oriented language found in elementary inkprint textbooks should be studied with a view to testing its efficacy for the visually handicapped child.

Task 2 Development of geographical concepts in blind children

Project Personnel Frank Franks and Carson Nolan

Purpose

The ability to recognize, identify, and discriminate tactile forms, textures, and symbols by blind students is regarded as essential for reading embossed maps. The value of models, embossed materials, and tactile aids in the education of blind children has been recognized for sometime. In the early 1930's, Merry and Merry (1933) explored the ability of the blind child to recognize embossed pictures. Cutsforth (1930) analyzed the relationship between tactual and visual perceptions in sighted college students in an effort to clarify some of the issues on tactual perception. Hayes (1937) attempted to determine the extent of blind students' information in geography and their ability to apply this knowledge. He found the blind testing near sighted students on geographical information, but decidedly below on map tests. Relevant studies in tactual perception, map design, and research have been reviewed by Nolan and Morris (1963). The limited quantity of research in map-reading is concentrated in these areas.

While efforts in tactual perception have undoubtedly contributed to the improvement of embossed maps, researchers have left relatively untouched the problem of development of geographical concepts necessary to interpret these forms, textures, and symbols in map-reading.

It was the purpose of this study to determine blind students' knowledge of 70 basic geographical features and to determine if the terms, when used as a test, discriminate among grade groups. It was hypothesized that results of the study could provide baseline information for further study in teaching geographical concepts to blind students.

Procedure

A test consisting of 70 geographical terms was administered individually to each student. The student was asked to define each term orally. The examiner recorded each response on an answer sheet. Responses were recorded and rated _0_, _1_, and _2_. The _2_ rating represents an "adequate" operational concept which includes a definition and at least one descriptive response. The _1_ rating indicates a partial concept consisting of either definition or description. The _0_ rating indicates either an incorrect response or no response.

Materials

A 70 item test using basic geographical terms identified from analysis of fourth, fifth, and sixth grade social studies textbooks was developed. The terms which composed the test are presented in Table 1.

Table 1

Basic Geographical Terms Used as a Test

Section I	Section II	Section III
(grade 4)	(grade 5)	(grade 6)
ocean	current	basin
mountain	delta	canal
lake	divide	cape
island	downstream	dike
canyon	elevation	fiord
gulf	glacier	foothills
equator	iceburg	marsh
highland	isthmus	monsoon
continent	jungle	rapids
channel	mountain peak	reef
coast	peninsula	savanna
valley	port	steppe
hill	river basin	tundra
forest	sound	inlet
swamp	source (of a river)	llano
plateau	strait	pampa
plain	timber line	rain forest
desert	tributary	oasis
prairie	tropics	latitude
reservoir	volcano	longitude
bay	North Pole	
river	South Pole	
seashore	antarctic	
arctic	mouth (of a river)	
harbor	mountain range	

Subjects

A total of 75 blind students from four residential schools, fifteen each from grades 4, 6, 8, 10 and 12, were used in the study. Students were selected randomly in the 76-139 IQ range. Regularly enrolled students under the age of 21 were accepted. Ages ranged from nine to twenty years. Mean ages and IQ for students at each grade are presented in Table 2.

Table 2

Average Age and IQ for Each Grade

Grade	Mean Age	Mean IQ
4	10.6	99.7
6	14.3	98.5
8	15.1	100.6
10	16.3	110.4
12	18.2	112.5

Results

Results indicate that the three levels of terms used in the test do discriminate among grade groups. Namely, terms in Section I are recognized by more students in each grade than terms in Section II. More terms in Section II are recognized by more students in each grade than terms in Section III. Results of this part of the study are given in Table 3.

Table 3

Percent of Geographical Terms Recognized

Grade	Section I (25 terms)	Section II (25 terms)	Section III (20 terms)	Overall (70 terms)
4	55%	28%	11%	33%
6	74%	55%	33%	55%
8	64%	47%	32%	48%
10	83%	70%	55%	70%
12	76%	60%	50%	63%

The highest group performance was achieved by the tenth grade with an overall score of 70%. This score is relatively low. It indicates that the highest scoring group was able to define or explain less than three-fourths of the geographical terms drawn from fourth, fifth, and sixth grade social studies curriculum and materials.

Although no word analysis was made, an inspection of the social studies and science curriculum indicates that repetition of many of the terms occur at certain grade levels. Table 4 was constructed in an effort to determine the effect of repetition on overall scores.

Table 4

Effect of Repetition on Overall Scores

Grade	Overall Scores	Differences Between Grades
4	33%	
6	55%	+22%
8	48%	- 7%
10	70%	+22%
12	63%	- 7%

The overall score for the grade six group is 7% higher than for the grade eight group. The sixth grade curriculum provides repetition for fourth and fifth grade terms, as well as providing additional terms at the sixth grade level during the year the study was made.

Scores for the tenth grade group was 7% higher than for the twelfth grade group. There is repetition of many of the terms in ninth and tenth grade social studies. In ninth and tenth grade science there is a reintroduction of many of the terms in such new contexts as physical and earth science.

From sixth to eighth grade and from tenth to twelfth grade-periods--when there appears to be less repetition of terms--scores tend to drop.

Conclusions

1. A number of the geographical concepts tested are relatively unknown at several grade levels.

2. Higher scores at some grade levels appear to be a result of repetition of terms in curriculum content, especially in social studies and science.

3. Generally, increased repetition of terms appeared to contribute to higher overall gains.

4. Overall gains due to repetition were short-lived and decreased when repetition was reduced.

5. Gains acquired through much repetition and reintroduction of terms in different contexts were greater, but also diminished noticeable over relatively short periods of time.

6. The presence of a patterns of increased learning through repetition is supported by the data presented.

Task 3 Measuring geographical concept attainment in visually handicapped students

Project Personnel Frank Franks and Carson Nolan

Purpose

In an exploratory study of the development of geographical concepts in blind students, Task 2 identified 70 geographical terms through curriculum analysis of fourth, fifth, and sixth grade social studies textbooks. These terms were administered as a test to 75 Braille students to determine their knowledge of basic geographical concepts. It was found:

1. That a number of the concepts tested were relatively unknown at several grade levels,
2. That higher scores at some grade levels appeared as a result of repetition of the terms, and
3. That overall gains due to repetition were shortlived and decreased when repetition was reduced.

When utilized as a test these 70 items were administered orally and individually to each student tested. The student defined, identified, or explained the terms and the examiner recorded responses on a separate answer sheet. This process was laborious and very time consuming. The need for a short-form group test for research and for educational purposes prompted this investigation in measurement of geographical concept attainment in visually handicapped students.

It was the purpose of this study to develop a short-form instrument for measuring geographical concept attainment of visually handicapped students which will be of value to educators and researchers. The study was designed:

1. To develop a short-form group test (40 items) for visually handicapped students which will allow them to record their own responses.
2. To administer this test to Braille and large print readers.
3. To compare performance scores of Braille readers from the longer individual test (70 items) and the short-form group test (40 items), and to compare performance scores of Braille and large print readers as compared with Braille readers on the longer individual test.
4. To determine if differences occur between Braille and large print readers on the 40-item test.
5. To develop two equivalent tests (20 items each) for evaluating geographical concept attainment of visually handicapped students.
6. To administer the 40-item test to the total population of visually handicapped students available in the programs used in the study to obtain a practical test of reliability.

Procedure

A multiple choice test was administered orally to mixed groups of Braille and large print students. Each item was read twice. Items were repeated upon request at the time the item was read, but the examiner did not go back to previous items. Each student recorded his answer on a separate answer sheet.

Special answer sheets in Braille and large print were prepared. Each student marked his choice of answer (a, b, c, or d) on the appropriate answer sheet, using a soft-point graphite pencil. All students had used this procedure in previous testing situations, consequently no difficulty in recording of responses was expected. Students were permitted to change answers by circling the answers they wished to change and then by marking through the final choice using the regular procedure. Assistance was given when requested.

Some half-dozen visually handicapped students fitted with hearing aids were tested. These students were seated near the examiner to insure their hearing clearly the items as they were read.

Materials

Forty geographical terms from the original list of 70 terms in the exploratory study (referred to as the 70-item test in the text following) were selected to make up items for the Geographical Concepts Information Test (referred to as the 40-item test in the text.) These 40 items were all nouns and represented basic geographical concepts which could be found specifically or located generally on relief maps. The remaining 30 items were geographical concepts which were repetitive or were concepts which could not be represented on relief maps.

Subjects

A total of 48 visually handicapped students, 24 Braille readers and 24 large print readers, were selected equally from grades 6, 8, and 10 in two residential schools. Students were selected randomly in the 80-140 IQ range, when possible. IQ scores for the total group ranged from 84 to 137 with an overall mean of 99.5. Students below the age of 21 who were enrolled in academic programs were included. Ages ranged from 12 to 20 years. No students were included who had been in public school programs within the past three years. Nor were students included for whom onset of visual impairment occurred after the age of five years. All students were in the regular school program and none were receiving psychological or psychiatric services for emotional disorders.

Age and IQ averages for Braille readers and for large print readers are presented for each grade level in Table 1.

Table 1

Mean Age and IQ for Braille and Large Print Readers (N=48)

	Braille		Large Print		Overall	
Grade	Age	IQ	Age	IQ	Age	IQ
6	15	95	13	97	14	96
8	14	102	15	99	15	101
10	17	102	17	100	17	101

Results

No problems occurred from mixing Braille and large print students from different grade levels. Large print students, however, were able to record their answers faster than Braille students. Occasionally those students with hearing aids requested a few of the more difficult items to be repeated, but no unusual problems were observed in the testing situation.

Analysis of the data reveals the same pattern of performance for both Braille and large print students on the 40-item test as was found for Braille students on the 70-item test, that is, sixth-grade performance scores were higher than eighth-grade scores, with tenth-grade performance highest. Percentage of correct responses for the two groups are given in Table 2.

Table 2

Percentages of Test Items Answered Correctly for Braille and Large Print Readers

	70-Item Test		40-Item Test			
Grade	Braille	(n)	Braille	(n)	Large Print	(n)
6	55%	15	61%	8	67%	8
8	48%	15	56%	8	60%	8
10	70%	15	72%	8	69%	8

Comparison of mean difference between Braille and large print groups through use of the test showed no significant differences for any grade on the 40-item test. Because no significant trends were noted in these preceeding two-group non-directional comparisons, no further analyses were made.

A split-half procedure (Gulliksen, 1950) was utilized to produce two equivalent test forms. Distribution of items was made according to item difficulty as reflected in the number of correct responses on each item.

Items were distributed until twenty items had been assigned to each of the two lists. This method of assignment was selected since there was no stringent time limit in the testing procedure and since the error probabilities of each item were independent. Inspection revealed some clustering of related geographical items in the two lists. Reassignment of several related items of similar difficulty was made to reduce this bias.

Correct responses for each item included in the two equivalent test forms are compared in Table 3 for the 48 students from grades 6, 8, and 10.

Table 3

Comparison of Distribution of Correct Responses for Equivalent Test Forms (48) for Grades 6, 8, and 10

Test A	Number of Correct Responses	Test B	Number of Correct Responses
1. Beach	46	1. Harbor	44
2. Ocean	42	2. Mountain	42
3. Port	42	3. Volcano	42
4. Mountain peak	42	4. Island	39
5. Dike	39	5. Foothills	39
6. Hill	37	6. Seashore	37
7. Reservoir	37	7. Range of mountains	37
8. Highland	34	8. Peninsula	34
9. River	33	9. Canyon	34
10. Plateau	31	10. Timberline	32
11. Valley	30	11. Canal	32
12. Strait	30	12. Plain	31
13. Isthmus	26	13. Divide	30
14. Channel	24	14. Delta	27
15. Prairie	24	15. Tributary	24
16. Mouth of a river	23	16. Bay	22
17. Gulf	22	17. Lake	22
18. Sound	21	18. Inlet	20
19. River basin	18	19. Basin	15
20. Cape	16	20. Source of a river	15
Mean	30.85	Mean	30.90
S.D.	8.89	S.D.	8.86

Reliability was assessed by presenting the 40-item test to the 154 visually handicapped students enrolled in the two schools from which the 48 subjects previously had been drawn. The reliability of the 40-item test was .86 when computed for all 154 subjects in the available sample.

Summary

1. A 40-item test measuring geographical concept attainment of visually handicapped students was developed which allowed students to record their own responses.

2. A comparison of performance scores of Braille readers and large print readers indicates that the pattern of performance for these groups tested on the short-form test (40 items) is comparable to the pattern of performance of Braille students tested on the longer individual test (70 items).

3. No significant differences were found between Braille readers and large print readers on the 40-item test.

4. The 40-item test was divided into two equivalent 20-item forms.

5. A practical application of the 40-item test verified its reliability with the population tested as an instrument for evaluating geographical concept attainment of visually handicapped students in educational programs.

Task 4 Teaching geographical concepts through use of landforms

Project Personnel Frank Franks & Richard Baird

Purpose

The limited quantity of research in map reading has focused on such problems as the perception of tactile forms, textures, and symbols as they appear on embossed maps, with little emphasis on the development of basic geographical concepts by the students who are to use these maps. It was felt that more information on geographical concept attainment of visually handicapped students would add to basic, but so far overlooked, dimension to studies in map design and map legibility.

It was the purpose of this study to test a set of eight landforms (tactile physical maps) to determine the ability of braille and large print readers to identify and locate tactual and chromatic representations of 40 basic geographical concepts as they appear on tactile physical maps. The 40 concepts are listed in the previous study.

Procedure

An introductory landform with a small island (a smooth raised yellow area) located in an ocean (a textured level blue area) was presented to each student for examination. Texture and color coding was explained. Opportunity to ask questions was given. Additional color coding was explained when landform II was presented. Landform II contained all of the colors used in coding the landforms.

The following procedure was used in testing the landforms:

1. Each student was tested individually.

2. The list of terms to be identified on each landform was read aloud as the student made a gross exploration of the landform.

3. The definition of each item to be identified was read and the student was asked to find its representation on the landform.

4. Each item was read twice and was repeated on request.

5. Responses were recorded by the examiner. (e.g. The student touched the correct geographical feature on the landform.)

6. The landforms were tested sequentially from landform I through Landform VII.

Materials

Eight raised surface landforms were constructed of 15 mil high impact styrene using a vacuumform process and were designed to provide the best possible tactual and chromatic discrimination for use by visually handicapped students. A brochure picturing and describing the final form of these materials appears in Appendix B.

Tactual coding: Precisely defined scaling of elevations of land areas and of sizes of various land and water areas was not maintained when it was necessary to exaggerate an area to increase contrast and/or tactual discrimination of the geographical concepts represented. However, the following general guidelines were observed:

1. Tactual and chromatic symbols on landform represented real things on the earth. Small symbols on the landform represented big things on the earth.

2. General overall size perspective, however, was maintained although not to scale. Oceans were larger than lakes; mountains were higher than hills.

3. Water areas (oceans, lakes, rivers) were represented on landforms by a level rippled surface that varied 1 mm. and was very different tactually from the raised smooth surface of land areas.

4. Boundaries between adjacent land areas and between water areas (mountain, hill, gulf, bay) were made as discriminable as possible.

Each landform measured 8 inches square. All land areas were smooth surfaced with a maximum rise of 2 3/8 inches. Landforms were numbered in braille and large print in the lower right hand corner.

Chromatic coding: Colors used on the landforms were blue for water, yellow for lowlands, green for hills, red for mountains, white for snow-capped peaks, and black for dams and dikes. The exact hues and color scheme were selected according to the following guideline:

1. Primary hues were used when possible. Mixtures of colors were avoided.

2. The number of hues utilized was limited to the minimum number actually necessary.

3. Chromatic contrast was maximized.

4. Reflectance (luminance) contrast also was maximized to facilitate visual inspection of the landforms by low vision students.

5. Within the above restriction, hues selected were as consistent as possible with the existing color scheme used on maps and globes produced by the American Printing House for the Blind.

Table 1 presents the color scheme used and the reflectance values for each hue.

Table 1

Color Scheme and Reflectance Values on the Landforms

Area identified	Color Shade used	Reflectance value
Water (oceans, lakes, etc.)	blue	17%
Lowland areas (first land level)	yellow	85%
Hills and mountains (second land level)	green	33%
Mountains (third land level)	red	15%
Mountain peaks (fourth land level)	white	87%

Subjects

A total of 48 visually handicapped students from grades 6, 8, and 10 in two residential schools were selected. Eight braille readers and 8 large print readers from each grade were included. IQ scores for the total test sample ranged from 84 to 137 with an overall mean of 99.2. All students were enrolled in academic programs and ranged in age from 12 to 20 years. No students were included for whom onset of visual impairment occurred after the age of 5 years. All were in the regular school program and none were receiving psychological or psychiatric services for emotional disorders. None had any apparent sensory-motor disfunction of the hands. Mean age and IQ scores for braille readers and for large print readers are presented for each grade level in Table 2.

Table 2

Mean Age and IQ for Braille and Large Print Readers by Grade Level

	Braille (N = 24)		Large Print (N = 24)		Overall	
Grade	Age	IQ	Age	IQ	Age	IQ
6 (N = 16)	15	95	13	97	14	96
8 (N = 16)	14	102	15	99	15	101
10 (N = 16)	17	102	17	100	17	101

Results

Overall percentage of correct identification of the features illustrated on the landforms was 83.5 percent. The mean and percentage scores for all subjects in this experiment are presented in Table 3.

Table 3

Mean and Percentage Scores for Braille and Large Print Groups by Grade Level

Grade	Braille	Large Print	Combined
6	28.13 (70.3%)	34.75 (86.9%)	31.44 (78.6%)
8	29.88 (74.7%)	33.00 (82.5%)	31.44 (78.6%)
10	36.13 (90.3%)	38.50 (96.3%)	37.32 (93.3%)
Total	31.38 (78.5%)	35.43 (88.6%)	33.40 (83.5%)

An analysis of variance was made of scores grouped by grade level and mode of reading. The analysis indicated significant effects due to grade level ($p < .01$) and mode of reading ($p < .01$) and a significant interaction ($p < .01$). Table 4 presents the analysis of variance.

Table 4

Summary Analysis of Variance Effects of Grade Level and Mode of Reading

Source	df	MS	F
Reading mode (A)	1	196.02	11.72*
Grade (B)	2	122.72	7.34*
A X B	2	302.67	18.11*
Error	42	16.71	
Total	47		

*< .01

The generally high level of performance of all groups on the identification task indicates that the geographical concepts illustrated on each landform were legible and readily identifiable. The significant differences between braille and large print readers was probably due to the effectiveness of the chromatic coding scheme in facilitating the performance of the subjects with some residual vision. The efficacy of the chromatic cues was not limited to large print readers, however. It was observed that a number of braille readers (who were educated as blind and had used braille exclusively in written communication) made almost exclusive use of visual cues in inspecting the landforms. Apparently, the chromatic and reflectance contrasts were such that they provided important information even for those braille readers with very limited residual vision.

Conclusion

The results of this study indicate that the series of three-dimensional raised surface landforms reported here provide highly discriminable illustrations of 40 basic geographical terms for use by visually handicapped students. The system of tactual coding which was developed provides easily discriminable surface areas. The chromatic coding system utilized on the landforms also provides effective, highly discriminable cues, even for some braille readers with extremely limited residual vision. The use of these materials should greatly facilitate both instruction and evaluation of geographical concept attainment of the visually handicapped student. Implications for use with exceptional children other than visually handicapped students should be investigated.

Task 5 Use of landforms to teach geographical concepts to young visually handicapped students

Project Personnel Frank Franks and Richard Baird

Purpose

This study, along with Tasks 2, 3, and 4, explored geographical concept attainment in visually handicapped students as a basis for improving their ability to interpret tactual maps. It was felt that more information on the instruction of geographical concepts and the attainment of these concepts by visually handicapped students would add a basic but, so far, overlooked dimension to studies in map design and map legibility.

The purpose of this study was to determine the feasibility of using raised surface landforms (tactile physical maps) as a primary grade level aid for instruction of basic geographical concepts. To accomplish this, a special instructional procedure was developed for teaching 20 of the more basic geographical features. Further, this instructional procedure was evaluated at grades 1 through 4, a level at which little systematic instruction of geographical concepts appeared to have been given.

Procedure

All students were first given an introduction to map reading techniques by their regular teacher. This introduction dealt with directional concepts which would be useful in inspecting the landforms (e.g. "up", "down"; "right", "left") rather than specific geographical concepts. Students in grades three and four were then given a verbal pretest to determine their initial level of geographical concept attainment. The pretest and the posttest were comprised of the same 20 items. The pretest consisted of reading the definitions of the twenty selected geographical terms one at a time to the students and having them select and record their answers on a multiple-choice answer sheet to take the pretest.

At the conclusion of the instructional program, the posttest was conducted. This test required the students to locate (touch) each of the 20 concepts illustrated on a composite landform as its definition was read.

A group instructional program which utilized the landforms as the primary classroom aid was developed. The instructional program consisted of the 22 items indicated in the list of geographical terms herein. The terms were defined, explained, and discussed. The small individual landforms were used to illustrate the concepts as they were presented. The students were encouraged to locate and study the concepts as illustrated on the landforms. Assistance was given upon request. All students progressed through this program. Two 20-30 minute sessions per day for five days were conducted.

Materials

Six landforms which tactually and chromatically illustrated 22 basic geographical concepts were selected from the eight landforms previously described (Task 4). Each landform was molded of 15 mil styrene by a Thermoform process and measured eight inches square with a maximum rise of 2 3/8 inches.

A list of the twenty geographical concepts (with descriptions) tested is presented below.

1) Ocean
2) Island
3) Lake
4) Seashore (coast, coastline)
5) Beach
6) Hill (green, high, rounded top)
7) Mountain (red, higher, pointed top)
8) Valley (yellow, low, wide)
9) Canyon (yellow, low, narrow)
10) Reservoir (blue, rough)
11) Basin (yellow, very low, bowl shaped)
12) Plain (yellow, low, very wide)
13) Plateau (green, high, flat)
14) Channel
15) Canal
16) Gulf
17) Bay
18) River
19) Source of a river
20) Mouth of a river

The 20 concepts illustrated on landforms 1 through 5 comprised the items on both the pretest and the posttest. In addition, a larger composite landform illustrating these 20 concepts was developed. It featured the same tactual and chromatic cues as the smaller landforms and mrasured 20 / 16 inches with a maximum rise of 1 1/2 inches. The composite, which was used for the posttest presented the concepts in a topograpcical arrangement that was somewhat different than that of the smaller landforms.

Subjects

A total of 22 visually handicapped students from grades 1 through 4 were selected from a residential school. There were six students each from grades 1, 3, and 4, and four students from grade 2. All students at these grade levels were included in the study. Approximately one-half had some residual vision and half were totally blind.

Results

The percentage of correct identifications on the verbal pretest (grades three and four) was 51.5%. On the posttest, the percentage of correct identifications wer 97.2% overall and 99.5% for grades three and four. Table 1 presents the mean number and percentage of correct responses for all subjects on the landform posttest. Table 2 presents a comparison of pretest and posttest scores for grades three and four.

Table 1

Mean Scores and Percentages of Correct Responses on the Posttest for Grades 1 through 4

Grade	Mean Score	Percentage Correct
1	18.3	91.5%
2	19.7	98.5%
3	19.8	99.0%
4	20.0	100.0%

Table 2

Comparison of Pretest and Posttest Scores for Grades 3 and 4

Grade	Pretest	Posttest	Percentage Improvement
3	9.3	19.8	52.5
4	11.3	20.0	43.5

As in the previous study, a number of students who had been educated as braille readers were observed using visual as well as tactual cues to locate the geographical concepts illustrated on the landforms.

Summary

The mediocre pretest scores of the students in grades 3 and 4 reflect the fact that geographical concepts often are not systematically introduced to visually handicapped students at these grade levels. The instructional procedures developed in this study were specifically oriented for use with landforms. The results support the hypothesis that raised-surface landforms can be used as effective classroom aids in teaching geographical concepts to visually handicapped students, including those in the primary grades. Students in grades 1 and 2 performed so well on the final test that their scores were very similar to those of the students in grades 3 and 4.

The very marked performance gains registered by grades 3 and 4, and the generally high performance of all grades, may partially reflect the similarity between the instructional program and the final test. Nonetheless, the results do indicate that this instructional program utilizing landforms can be used very effectively in teaching geographical concepts to visually handicapped students as early as the first grade.

The use of landforms in instructional programs provides a foundation for further research in map design and map legibility and prompts an investigation into the feasibility of incorporating these materials into the instructional programs of all students who exhibit learning deficits that are amenable to such remediation.

Task 6 Consumer panel meeting: Map reading for primary grade visually handicapped students (January 13-15, 1972)

Project Leader Frank Franks

Purpose

The purpose of this meeting was to identify deficits in map reading viewed in terms of needs across the social studies curriculum with emphasis on the introductory or primary grade level. Participants were asked to review the APH introductory map reading materials which contained instructional programs with relief maps developed to introduce map reading to very young visually handicapped students. Specifically, the materials exposed young blind students to geographical features, provided general map orientation, and introduced tactile areal, linear, and point symbols. Participants made a number of comments and recommendations specific to the instructional program reviewed.

Other curricular areas in social studies also were examined to determine where deficits in instructional materials are believed to exist for visually handicapped students, to identify specific aids necessary for teaching basic concepts in these areas, and to suggest priorities for development of relevant educational aids and materials.

Participants

Mr. John T. Bennett, Social Studies Department, Indiana School for the Blind, Indianapolis, Indiana
Mr. Gary Coker, Tennessee School for the Blind, Nashville, Tennessee
Mrs. Mary Nell Council, Tennessee School for the Blind, Nashville, Tennessee
Mrs. Edith Georgi, Kentucky School for the Blind, Louisville, Kentucky
Mrs. Ruth Holmes, Illinois Braille and Sight Saving School, Jacksonville, Illinois
Dr. Arthur Lown, Vision Center, Atlanta, Georgia
Dr. Willard Smith, Department of Education, George Peabody College, Nashville, Tennessee

Results

The following suggestions and recommendations on the Introductory Map Reading Program were made by participants in the meeting:

1) In the absence of appropriate introductory and readiness map reading materials for primary grade visually handicapped students, the map reading project examined by the panel is supported in content and approach. There is an immediate need for these materials. Participants are not aware of any appropriate educational materials which teach the concepts introduced in this instructional program.

2) It is imperative that the personal aspects in the development of the visually handicapped student parallel those of this academic

development. The members of the panel recommend that upon completion and evaluation of this map reading project, the project again be reviewed for purposes of incorporating a personal dimension within the program. This personal dimension would apply the basic concepts presented in the instructional program and would facilitate interaction of the student with his environment. Where appropriate, activities involving the personal dimension should parallel map activities, and should be presented as part of a comprehensive program built upon relating these concepts to maps. The program would incorporate activities that are necessary for the student to function in his environment, and these activities would be directly correlated with map reading and exploration of the environment.

3) Introduction of the geographical Landform Models should be considered prior to presenting the Introductory Map Reading materials. The Map Reading materials might be introduced more meaningfully when readiness is demonstrated through comprehension of geographical concepts presented in the primary level unit of the Landform Models.

4) The educational aids review participants recognize the need for associating each map symbol with an appropriate geographical feature in the immediate environment. The teacher is encouraged to substitute appropriate geographical features for those presented in the instructional program which may not exist in the student's environment. (If there is no motel in the student's community, the teacher should substitute fire station, bakery, or some appropriate geographical feature.)

5) It is recommended that the use of keys on maps for young visually handicapped students be delayed until such time as map reading skills are formally introduced.

6) Teachers' manuals containing instructional procedures should be provided with the Introductory Map Reading materials. The meeting recommends that the instructional program be utilized as a guideline to instruction. (The participants encourage innovation and creative activities which reinforce and expand the concepts presented as opposed to a verbatim repetition of the manual's instructions.)

7) The review meeting recommends that the word "landform" be deleted and the word "map" be used throughout the instructional program.

8) The quotation marks should be excluded from the instructional program.

9) Participants agree that the words "up" and "down" and "top" and "bottom" should not be used as directional referents in introducing map reading. "Near" and "far" and cardinal directions (North, South, East, and West) are more appropriate and are less confusing.

10) Participants suggest a follow-up meeting to review and moniter the development of an adequate instructional program in map reading leading to the development of geographical concepts at the primary grade level. The follow-up meeting should emphasize personal dimension aspects as indicated in Item 2, this section.

11) Participants request prototypes and instructional programs to review, when the materials are available.

12) The review meeting recommends that a workshop or in-service training be conducted by APH with a number of teachers from a cross-section of programs for visually handicapped students. The purpose of this workshop should be the instruction of teachers in how to use the Introductory Map Reading materials. The lack of adequate instruction and workshop training in the use of new instructional programs was noted as a significant deficit in social studies curricula.

The following suggestions and recommendations on simplified continental relief maps for young visually handicapped students were made:

1) A need for simplified continental relief maps exists. The APH Plaques are not adequate for use by younger (elementary) blind students.

2) Indication of scale should be included on each map.

3) Notation of scale differences in the various maps and other relevant information not on the map should appear in accompanying written materials.

4) The panel agrees that three colors would be desirable for coding water, land, and the higher mountain areas. An additional color on the highest mountain peaks for use by low vision students is suggested, if it does not substantially increase the cost of the set of maps.

5) Neither longitude and latitude nor directional referents should be included on these nor any other introductory relief maps.

6) The continental relief maps should be used in conjunction with the globe to teach location and direction.

7) Use of the Landforms is suggested for teaching or reviewing specific geographical concepts which appear too small for clear inspection on the continental relief maps.

Additional suggestions and recommendations in the following areas were made in discussion sessions on materials needs in social studies.

Atlases:

1) The review meeting recommends that a panel composed of teachers, high school blind students, and other appropriate specialists and consumers be

formed to evaluate braille atlases currently produced by APH and to make recommendations for improving atlases.

2) A general atlas should be prepared for use with textbooks at appropriate grade levels rather than the preparation of a separate set of atlases for each social studies series.

3) It is recommended that efforts be made to correlate and standardize the map symbols and scales throughout to minimize confusion.

Outline maps:

1) Individual desk-size (12" x 16") outline maps of individual states showing (as space allows) the capital, chief cities, and rivers are needed.

2) It is not essential for these individual state maps to be of uniform scale since they can be used in conjunction with available scaled U. S. maps. The scale for each map should be considered for each state individually.

3) The inclusion of other kinds of information (i.e., population centers, transportation arteries) on state outline maps should be considered.

Cassettes:

1) The utilization of cassettes for appropriate instructional materials (when available) should be considered in the final packaging of social studies educational aids, including the Introductory Map Reading materials. Students would be able to review materials with a minimum of supervision and older students would be able to progress independently at their own rate.

2) Tone indexing of cassette instructional materials in social studies and map reading should be considered when tone indexing has been perfected.

Models:

1) Educational Models in social studies should be utilized wherever possible to facilitate learning. Models may be used to introduce or reinforce concepts. A model provides a "Gestalt"--the image of the whole--which non-vision students generally cannot gain, either visually or tactually in reality. Models should be used in conjunction with real features and items in the environment where possible.

2) Models should be developed in terms of scaled perspective. In a collection of animal models, a horse should appear larger than a dog.

3) The possibility of attaching two thermoform models together to form a whole model should be investigated. The cross-sectional models

developed at APH are good, but additional information can be presented by combining component parts to form whole models.

4) The difficulty with many available models is their highly visual orientation, their excessive detail, and their fragile construction. Sturdy, simplified "pull-apart" models with a minimum of detail should be considered when developing educational aids.

5) Although accompanying instructional programs are valuable and desired, participants feel that having the models available is of higher priority than having the instructional programs. Existing curricula contain instructional programs which could utilize the models.

6) It is recommended that the APH IMRC explore the possibility of developing a central catalog of sources of appropriate educational models.

7) Participants recommend that sets of appropriate social studies models be developed. Among the collections suggested are:

- a) Strata, cross sections of the earth, rock formations
- b) Rock and mineral collections, with weight differences and differences in tactual surfaces; shell collections; building material samples; etc.
- c) Historical models
- d) Architectural models and styles; progression of architectural structures
- e) Animals
- f) Transportation vehicles

8) The possibility of APH developing models which can be made available on a rental basis--on quota--to educational programs should be explored. Models in this category would be those which might be too expensive for purchase by individual programs.

Overall recommendations:

1) The need for developing three-dimensional aids to which concrete experiences and geographical features can be anchored is emphasized. Such materials are recognized by the panel as important educational aids to assist young visually handicapped students in making a better transition from the real environment than attempts to illustrate the environment through abstract raised-line drawings in braille textbooks.

2) Simplified "pull-apart" models with a minimum of detail should be considered when developing tactual materials (e.g., cross-section of the earth, rock formations).

3) No braille or minimal braille should be embossed on individual educational aids or materials developed for use at the primary grade level. If and when braille is needed, dymotape or other techniques can be used for labeling those parts which the teacher wishes to

emphasize. Learning to manipulate or utilize an instructional aid should not be complicated by, nor the student distracted by, the appearance of braille characters on the aid.

4) Teachers' manuals should be included with educational aids. These manuals should be in outline or abbreviated form to allow flexibility and creativity in their use.

5) Displays of educational aids at national and regional meetings and at special conferences and workshops should be supplemented with demonstrations by professional personnel who are qualified to discuss the educational implications of the materials.

6) Although the APH social studies educational aids (Landforms and Introductory Map Reading materials) examined were developed to introduce basic concepts to young visually handicapped students, the participants feel that the materials have educational implications for most students throughout the social studies curriculum. Therefore, these materials are recommended as instructional and reference aids wherever and whenever needed in the social studies curriculum.

7) It is recommended that the final report of this meeting be presented in the AEVH Social Studies Workshop (Miami, 1972) with members serving as a panel to present and discuss the Report.

8) The participants commend APH for inviting participants who are actually involved in the teaching process. It recommends that APH continue to utilize such meetings as a means of evaluating the education aids it develops.

9) Participants suggest further APH field involvement. The feasibility of educators and consultants assisting APH in the development of instructional programs should be explored, with possible utilization of teachers during summer vacation and sabbatical leave.

Task 7 Introduction to map study: Teaching locational and directional referents to young blind students

Project Personnel Frank Franks and Roger Huff

Purpose

If young blind students are to gain the ability to interpret maps accurately, they first must observe natural and cultural features in the environment which are represented on maps. The sighted student begins very early to develop a repertoire of geographical concepts based on concrete experiences from which he constructs other more abstract concepts. Special efforts must be made with blind students to insure that features represented on maps are supported by concrete experiences. Each geographical feature which is represented on a map must be conceptualized in terms of the feature itself if adequate interpretation is to be achieved.

The lack of geographical knowledge, the lack of information in tactual perception, the lack of training and experience in map reading, and the lack of skill in map reading techniques are reviewed by Nolan and Morris (1971). Problems of achievement in the area of geography raised by Hayes (1937) recently have been confirmed in Task 2.

Nolan and Morris (1971) have suggested that the best place to begin research in map reading is at the conceptual level. They state that once concepts of orientation and geographic features of the earth are learned, the student can be taught map reading techniques and maps can be tested.

Four relevant studies at the conceptual level have previously been described in this report.

Sabaroff (1957) states that the overall objective for the primary grades is to help develop a geographic point of view, a better understanding of the relation of man to his environment.

The blind student has a great need to attain concepts of the common features in his environment and his everyday world as they relate to a growing concept of himself. The sighted student observes real or pictured landscapes. The non-sighted student is dependent upon varying degrees of tactual interaction with his environment. This interaction is limited and provides the student at best with a very restricted view of his environment.

The longer a child is without experiences which enable him to form accurate concepts of his environment, the harder it is for him to correct inaccurate concepts erroneously formed through incidental learning. The importance of readiness in map reading is to help the child to begin to observe and analyze the immediate world around him (home, school, local community) by providing structured learning experiences that can become the basis for comparing distant places to those with which he is familiar.

Lists of map reading skills and objectives suggested by geographers and educators (Sabaroff, 1957; Anderzohn, 1955; Barton, 1948; Chace, 1955; Fuller, 1943; Kohn, 1953; Meyer, 1948; Mitchell, 1934; Scarfe, 1956; Horn, 1937; Thralls, Hart, and Grossmuch, 1933; Whipple and James, 1947; Whittemore and Svec, 1947; and Mid-Century Commission on Outcomes in Elementary Education, 1953; Harris, 1967; Los Angeles City Schools, 1970) were examined in an effort to determine the concept areas which should be introduced at the primary grade level. The concepts suggested by these lists which appear to be most essential for young blind students who are beginning map study are locational and directional referents.

Because a number of locational referents which appear at the primary grade level are not used in technically locating geographical features, the focus at the primary level is on relative location. Directional referents generally are considered in terms of cardinal directions (e.g., north, south, east, west) and intermediate directions (e.g., northeast, southwest). Direction focuses on establishing the cardinal direction, north. These locational and directional referents are juxtapositional referents because they are interrelated--they are used to describe the location of one geographical feature or place in relation to another feature or place.

The purpose of this study was to develop and to evaluate an instructional program and an accompanying set of modified relief maps for teaching locational and directional referents to young blind students. The effectiveness of these materials was determined by gains in learning between the administration of a pretest and a posttest. The significant effects of degree of vision (mode of reading) and of chronological age on learning were also examined.

Procedure

Approximately two months in the field was required to complete pretest administration, instructional program presentation, and posttest administration. All data were collected by the project assistant. The principal investigator matched the experimental and control subjects.

Test administration and matching of subjects: The experimental subjects were pretested individually by the project assistant. The principal investigator then presented the instructional program to the experimental subjects while the project assistant pretested potential control subjects in the other schools. When all pretest administration was completed, the principal investigator made the best matched experimental and control groups possible using the pretest scores. The project assistant made a second visit to the experimental and control schools and postested individually all available subjects.

The posttest was administered under the same conditions as the pretest using the posttest map.

Instructional program presentation: The instructional program was taught by the principal investigator, with assistance from the regular class teachers, using six intact classes, grades K-5. All students were presented the same instructional program beginning with the first lesson. Younger students required more time to complete each lesson. They required more breaks, more varied activities to maintain interest, and more review and remediation.

Materials

The instructional materials used in this study consist of five relief maps, a pretest and a posttest, and an instructional program.

The five relief maps included a Pretest Map, a Posttest Map, and three maps used with the instructional program. The relief maps were constructed of 15 mil high impact styrene using a vacuum for process. Maximum relief was held to 1 1/4 inches. The maps were approximately ten inches square. Map size was held under ten inches square to reduce the map area to be explored by the small hands of young blind students.

The maps were chromatically, as well as tactually, cued. The chromatic cues--light yellow, blue, and green are colors which were found highly discriminable and which are used on all landform models produced at APH.

The three maps in the instructional program introduced sequentially areal, linear, and point symbols.

The pretest and the posttest consisted of 60 items each. Two equivalent items for each concept were included. Thirty concepts in eight concept areas were presented. These concept areas were: Location and Direction I (simple referents--near, far; middle, between; left, right), Location and Direction II (cardinal referents--north, south, east, west), Finding Corners I (using simple intermediate referents), Finding Corners II (using cardinal intermediate referents), Diagonal Movement to a Corner from a Reference Point I (using simple intermediate referents), Diagonal Movement to a Corner from a Reference Point II (using cardinal intermediate referents), Vertical Movement (far, near) and Horizontal Movement (left, right). The score on each test was the total number of correct responses on the sixty items.

A total of 80 subjects were used to evaluate the validity and appropriateness of the instructional program for use with young blind subjects. However, a larger number of controls were tested to increase the total number of subjects for the analysis of the internal consistency of the pretest and posttest. To determine the equivalency of the pretest with the posttest, only the scores of the control subjects were used.

The internal consistency of the pretest was estimated using the subjects in both the experimental and control study groups, including the extra control subjects tested, for a total of 145 subjects. The Kuder-Richardson Formula 20 (Guilford, 1954) yielded a coefficient of .94.

The internal consistency of the posttest was estimated using subjects in the control group including the extra control subjects who completed the posttest, for a total of 104 subjects. The Kuder-Richardson Formula 20 yielded a coefficient of .95.

The Pearson Product-moment correlation (Hayes, 1963) was computed using 104 control subjects to assess the degree of relationship between the pretest and the posttest. A correlation coefficient of .80 was obtained.

The instructional program consisted of thirteen lessons which sequentially introduced map reading concepts. The tasks to be performed were concept-related activities which focused on locating and/or moving from one geographical feature or reference point to another. Students located areal symbols (water, land, hills), linear symbols (road, river, bridge), and point symbols (house, church, tree); used locational and directional referents (e.g., far, near; left, right) and various symbols as reference points to locate other symbols; and performed activities which included cardinal (e.g., North, South) and intermediate (e.g., north-east, south-west) directions.

Subjects

Eighty legally blind subjects from three residential schools for the blind were used to evaluate the effectiveness of the instructional program using simplified relief maps. These subjects were classified by mode of reading (braille or print) as indicated in school records. Irregular distribution of the sample population made randomization of subjects infeasible. For purposes of this study, subjects were matched on pretest scores and then distributed by age to form equivalent groups. The subjects were divided into experimental and control groups, with the subjects in one school forming the experimental group which was matched with subjects from the two remaining schools to form an equivalent control group.

No significant differences between the braille experimental group and the braille control group were found either on chronological age ($\underline{t}$ = .0067, $\underline{df}$ = 38, $\underline{p} > .05$) or on pretest scores ($\underline{t}$ = 0.0000, $\underline{df}$ = 38, $\underline{p} > .05$). A breakdown of data on these students is presented in Table 1.

Table 1

Comparison of Braille Experimental and Control Groups
on Chronological Age and Pretest Scores
(Prior to Posttest)

	Experimental		Control	
S Number	Age (in months)	Pretest Score	Age (in months)	Pretest Score
1	153	18	154	26
2	143	27	147	29
3	140	27	145	26
4	137	27	139	19
5	134	12	136	26
6	132	26	134	12
7	131	23	133	24
8	131	10	124	51
9	123	52	117	11
10	119	51	117	16
11	112	12	114	47
12	110	2	105	16
13	104	13	105	11
14	100	10	98	9
15	97	11	93	1
16	92	16	90	11
17	89	16	88	12
18	86	10	85	4
19	83	2	85	9
20	70	8	76	13
Means	114.30	18.65	114.25	18.65
Standard deviations	23.36	13.62	23.92	12.92

No significant differences between the print experimental group and the print control group were found either on chronological (*t* = .0264, *df* = 38, *p* > .05) or on pretest scores (*t* = 0.0000, *df* = 38, *p* > .05. A breakdown of these students is presented in Table 2.

Table 2

Comparison of Print Experimental and Control Groups
on Chronological Age and Pretest Scores
(Prior to Posttest)

	Experimental		Control	
S Number	Age (in months)	Pretest Score	Age (in months)	Pretest Score
1	140	43	145	30
2	139	8	142	26
3	138	20	141	8
4	136	24	136	20
5	132	13	125	13
6	130	33	121	24
7	119	15	120	8
8	119	7	120	7
9	113	11	117	40
10	110	4	114	15
11	108	5	111	26
12	108	8	107	20
13	108	12	104	5
14	106	22	103	33
15	105	30	103	11
16	103	25	102	12
17	99	11	98	11
18	99	25	98	4
19	87	2	87	3
20	76	10	78	12
Means	113.75	16.40	113.60	16.40
Standard deviations	17.78	10.93	18.19	10.49

Results

A four-way analysis of variance was performed on pretest and posttest scores for all of the groups included in the study. Subject groups (experimental vs. control), mode of reading (braille vs. print), and chronological age (older vs. younger) were treated as between-subjects variables, and test scores (pretest vs. posttest) were treated as a within-subjects variable. A design schematic showing distribution of subjects among these variables is presented in Table 3.

Table 3

Design for the Analysis of Variance

	Experimental Group		Control Group	
(N = 80)	Braille	Print	Braille	Print
Older	10	10	10	10
Younger	10	10	10	10

The analysis of variance showed significant main effects between the experimental and the control groups ($F = 74.34$, $df = 1/72$, $p < .01$) with a higher overall performance for the experimental group, between the older and the younger groups ($F = 14.71$, $df = 1/72$, $p < .01$) with the older group achieving higher overall score, and between the pretest and posttest scores ($F = 325.29$, $df = 1/72$, $p < .01$) with the posttest scores higher than the pretest scores. No significant difference in performance between braille and print scores ($F = 1.08$, $df = 1/72$, $p > .01$) was found. The complete analysis of variance is shown in Table 4.

Table 4

Analysis of Variance for Correct Responses on Test Items

Source	df	SS	MS	F
Total	159	59,090.98		
Between Subjects	79	27,849.98		
Reading Mode (Braille-Print)	1	180.63	180.63	1.08
Age (Younger-Older)	1	2,464.90	2,464.90	14.71**
Groups (Experimental-Control)	1	12,460.90	12,460.90	74.34**
Reading Mode X Age	1	435.60	435.60	2.60
Reading Mode X Groups	1	136.90	136.90	.82
Age X Groups	1	3.03	3.03	.02
Reading Mode X Age X Groups	1	99.23	99.23	.59
Error	72	12,068.80	167.62	
Within Subjects	80	31,241.00		
Tests (Pretest-Posttest)	1	15,093.23	15,093.23	325.29**
Reading Mode X Tests	1	.63	.63	.01
Age X Tests	1	57.60	57.60	1.24
Groups X Tests	1	12,460.90	12,460.90	268.55**
Reading Mode X Age X Tests	1	108.90	108.90	2.35
Reading Mode X Groups X Tests	1	136.90	136.90	2.95
Age X Groups X Tests	1	21.03	21.03	.45
Reading Mode X Age X Groups X Tests	1	21.03	21.03	.45
Error	72	3,340.80	46.40	

** $p < .01$

One significant interaction was indicated in the analysis of variance. An interaction between subject groups and pretest and posttest scores revealed significant gains in learning for the experimental group over the control group ($F = 268.55$, $df = 1/72$, $p < .01$) as a result of the instructional program.

Discussion

The results of the analysis of variance performed on pretest and posttest scores for all of the groups included in the study show that the overall performance of the experimental group of students was significantly greater than the overall performance of the control group. The interaction of subject groups and tests further confirmed the value of the instructional program. These data support the hypothesis that an instructional program designed to teach sequentially locational and directional referents will enable young blind students to perform a number of related map reading tasks on simple relief maps.

No differential effects on learning locational and directional referents as a function of degree of vision (mode of reading) were indicated by the analysis of variance. No significant differences in overall performance between braille and print groups were found. Consequently, the applicability of the instructional program for both braille and print groups as the program now exists, without additional change or instruction, was verified.

The data revealed that the older group of students achieved a higher level of overall performance. The instructional program did have differential effects on learning directional and locational referents as a result of chronological age. A matched t test performed to determine the significance of the increase in performance from pretest to posttest for the older and the younger group as a result of the instructional program, however, confirmed that both groups made significant gains. Although the younger group of students exhibited less prior knowledge of the map concepts tested by the pretest and achieved a lower mean posttest score, the mean increase from pretest to posttest for this group was not significantly different from the mean increase for the older group. Thus the value and appropriateness of the instructional program and materials for both the older and the younger groups were confirmed by this performance.

High coefficients of equivalence for the internal consistency of the pretest and of the posttest were obtained using the Kuder-Richardson Formula 20. A high positive relationship between the pretest and posttest also was revealed by the Pearson product-moment correlation coefficient. Gains in learning for 26 of the 30 concepts taught in this program were significant beyond the .01 level. The low increase in learning on the four remaining concepts is attributed to prior knowledge of the concepts.

Summary

Results of the study confirmed the validity of the instructional program and its appropriateness for teaching locational and directional concepts to young blind students. On the basis of the results, it was concluded that similar educational materials may be useful for teaching a variety of concepts across curricula, that these concepts can be introduced early to young blind students through carefully planned instructional programs, and that the lack of reality in many educational materials can be reduced if the materials are oriented to the student's immediate environment.

Task 8 Lesson guides for geographical readiness

Project Personnel Hilda Caton, Lawrence Butterfield, Jr., Ina Kurzhals

Purpose

The lesson guides for geographical readiness were designed to provide experiential readiness activities in geography for visually handicapped children and thus, develop concepts needed for the study of abstract representations of geographical features which will be encountered in subsequent studies in geography. These lesson guides were developed in answer to the problem posed by the lack of geographic knowledge which is common to most visually handicapped children. Low performance in map reading tasks was demonstrated by Hayes as early as 1937, and again in Task 2. Much of the difficulty seems to lie in lack of training materials and procedures. In a study of 367 visually impaired subjects in the upper elementary through college levels, for example, Wiedel and Groves (1969) found that 72 percent reported either no training or very little training in map reading skills. Nolan and Morris (1971) found that 55 percent of their elementary and high school sample of visually impaired students reported no formal training and very little experience in reading maps; the remaining 45 percent remembered only minor training and map reading experience. Despite these evident voids in the typical program, blind and visually handicapped students are left to cope with spatial problems to the same or even greater extent than their sighted peers.

Nolan and Morris (1971) have suggested that the cluster of problems associated with inability to use maps can be broken most effectively through a conceptual approach. Once basic concepts of geographic features are acquired, effective map reading techniques can be taught. As background for such an effort, a study to identify geographical terms commonly found in children's stories, poems, music, and social studies textbooks was undertaken in Tasks 2, 3, and 4. The series of investigations involved (1) an extensive curriculum analysis to identify frequently used geographical terminology, (2) production of landform models for use by visually handicapped students, and (3) development of a conceptual test associated with the landform models.

Nolan and Morris (1971) also noted that the lack of geographical materials has led to a lack of basic geographic concepts and information among visually handicapped children and, thus, have pointed up the need for training in basic concepts in this area. Evaluation and use of the landforms (Task 4) also furnished information relative to the knowledge of geographic concepts held by visually handicapped children. This information was used as a basis of the development of the Lesson Guides for Geographical Readiness which are designed to teach these concepts.

Procedure

The following procedure was used in the development of the Lesson Guides for Geographical Readiness:

1. Geography texts, workbooks, and other sources were selected for analysis to identify concepts which would be included in the lesson guides.
2. The Landform Models, produced by APH, were reviewed to identify additional concepts to be included.
3. Concepts for inclusion in the lesson guides were then chosen and the first draft of the lesson guides was written.
4. Next, the lesson guides were reviewed by an in-house committee composed of staff members of the APH IMRC. Suggestions for revision were made by this committee and revisions based on these recommendations were made.
5. Subsequently, the lesson guides were evaluated by 5 expert teachers of visually handicapped children. These evaluators were furnished with an evaluation questionnaire consisting of questions related to the introduction and to individual lessons. Responses to the questionnaire were analyzed and suggestions for revisions were noted. Items which did not meet a criterion of acceptability by 80% of the evaluators, were revised or eliminated. In actuality, all items were considered to be acceptable with revisions.
6. Suggested revisions were made and the materials were submitted to APH for production.

Materials description

Nine lessons are included in the set of Lesson Guides for Geographical Readiness. These lessons can, and should be, adapted and modified to meet the needs of children in any educational setting or geographic area. If the specific geographic feature described in the lesson is not located in the region in which the lesson is to be used, a different feature which is similar may be substituted and the general format and activities in the lesson may be used as guidelines.

Each lesson contains a statement of its purpose, a listing of the geographical concepts introduced, a list of materials needed to conduct the lesson, descriptions of appropriate activities, and suggested evaluation procedures. Since these lesson guides are to be used at the readiness level, concepts and vocabulary related to the specific geographic features are presented on an introductory basis. Teachers who feel that their students require more intensive study of these concepts are encouraged to consult current geography texts in order to present them in more detail.

The lesson guides are organized as follows:

1. Lesson 1 — Introductory, provides an overall view of geographic features which are presented later in more detail.
2. Lesson 2-3 — Water areas on the surface of the earth: Water areas on continents and water areas not on continents.

3. Lessons 4-7 Land areas on the surface of the earth: Land areas near water, land areas surrounded by water, landform patterns of the continents.
4. Lesson 8 The shape of the earth, presents concept of the shape of the earth and the cardinal directions North and South as related to the use of globes.
5. Lesson 9 The earth as a home for all life, presents functions of the features of the earth and emphasizes the importance of knowing about the earth.

These lessons are designed so that the specific features are introduced and described and their relationships to each other, as well as their relationship to the overall structure of the earth's surface, are emphasized.

The appendixes include a glossary of geographic terms; a list of references; and lists of equipment, music, and poetry which may be used with the lesson guides. The glossary contains definitions of other terms related to geographic features which are not included but which are similar to these features. Teachers can use the glossary to select geographic features in their own location which can be substituted for those features in specific lessons which are not appropriate for that location. The reference list contains current curricular materials in geography which can be used to supplement information provided in the lesson guides. Specific titles and sources for obtaining them are included in the listings of equipment, music, and poetry.

Results

Results of the evaluation indicated that the lesson guides were critically needed for the development of geographical readiness. All respondents to the questionnaire indicated that they should be produced by APH. Major suggestions for revision were that the sequence of lessons be changed so that lessons related to specific and concrete features of the students' immediate environment be presented first, followed by lessons related to more general concepts, i.e. the shape of the earth. Also, recommendations for additional activities relating to experiences in the environment were made. These revisions have been made. The materials will be produced in the form of a pamphlet for use by teachers of primary grade visually handicapped students.

Concluding Statement

Research and development in the area of geography and social studies has shown that visually handicapped children lack concepts of their environment which enable them to deal with abstract representations of this environment in the form of maps. The Lesson Guides for Geographic Readiness were designed to provide these children with opportunities to interact directly and concretely with geographic features in their environment and to gain knowledge which will build the background they need to understand concepts presented in abstract form. Evaluators of the lesson guides indicated that they were, indeed, critically needed and that they were acceptable, with revisions. These revisions were made and the materials are now being prepared for production by APH.

Task 9 Prominent geographical features appearing on continental maps

Project Personnel Liborio Albano

Purpose

Prominent geographical features of continents were analyzed and compiled as a preliminary reference for the development of simplified continental relief maps.

Procedure

The following sequence of items were used for analyzing textbooks, maps, atlases, charts, and reference books to identify prominent geographical features which appear on the continents.

Land
Water
Ocean
Lake
Coastline
Mountain
Plain
Channel
Gulf
Bay
River

Land and water areas were first located. The order of location of remaining geographical features was determined by subjective judgment, relying often on proximity of features in the direction of scanning movement, and/or on their relatedness to previous features located. Frequency occurence of the above features in the texts analyzed were recorded. Consideration was given to the prominence and importance of the feature.

The following series of social studies textbooks was inspected to identify the use of geographical features in the primary grade curriculum:

Brandwein, P. F. et al. The Social Sciences: Concepts and Values. Grade I. New York: Harcourt Brace Jovanovich Inc., 1970.
Brandwein, P. F. et al. The Social Sciences: Concepts and Values. Grade II. New York: Harcourt Brace Jovanovich Inc., 1970.
Brandwein, P. F. et al. The Social Sciences: Concepts and Values. Grade III. New York: Harcourt Brace Jovanovich Inc., 1970.

The following related reference materials were reviewed to determine the grade levels at which specific geographical features are introduced in the primary grade curriculum:

Sequence Chart of Map and Globe Skills and Understanding. Los Angeles City Schools, Division of Instructional Services, Curriculum Branch. Chicago: Denoyer-Geppert Company, 1970.

Harris, R. M. The Rand McNally Handbook of Map and Globe Usage. (4th edition.) Chicago: Rand McNally & Company, 1969.
Sabaroff, R. E. A framework in developing map skills in primary grade social studies. (Doctoral dissertation, Stanford University) Ann Arbor, Michigan, 1957.
Johnson, E., et al. Map Skills for Today, Book 5, Ohio: American Education Publications Education Center, 1968.
Concepts and Inquiry Social Science Program. Prepared by the Educational Research Council of America, Cleveland, Ohio. Boston: Allyn & Bacon, Inc., 1970.

Continental maps in the following reference materials were inspected using the format:

World Atlas (Large type). Hammond Incorporated, 1969.

The World Book Encyclopedia (Large type). Vol. 20. Chicago: Field Enterprises Educational Corporation, 1964.

Results

The frequency of occurrency of the prominent geographical features appearing on each continent and for overall are presented in Table 1.

Table 1

Frequency of Occurrence of Geographical Features

Geographical Features	North America	South America	Asia	Europe	Australia	Africa	Total
Land	1	1	1	1	1	1	6
Oceans	3	2	3	2	2	2	14
Seas		1	2	3		2	8
Lakes	1					1	2
Mountains		1			2	1	4
Mountain Ranges	3	1	2	4	1	1	12
Plains	1	2	1		1	1	6
Peninsulas	2			1			3
Islands	5	1	2	1	1	1	11
Coastline (Shoreline)	2				1		3
Gulf	1				1	1	3
Bay	1						1
Channel				1		1	2
River	1	1	1	1	1	3	8
Total	21	10	12	14	11	15	83

The following locational referents appear at the grade I level in social studies texts and in map reading materials. The locational vocabulary presented and frequency of occurrence for each continent and for overall by term are presented in Table 2.

Table 2

Frequency of Locational Referents

Geographical Terms	North America	South America	Asia	Europe	Australia	Africa	Total
far	1	0	1	1	1	2	6
near	3	0	4	2	4	0	13
toward	2	0	0	0	0	0	2
around	3	1	1	1	3	1	10
along	3	1	2	1	1	2	10
*center	1	1	0	0	2	1	5
*edge	2	2	0	0	2	0	6
left-(hand) side	5	3	2	2	2	1	15
right-(hand) side	5	2	2	1	2	4	16
far left	2	1	1	1	0	2	7
far right	2	2	0	2	0	1	7
near right	2	1	0	1	0	2	6
near left	0	0	0	0	0	0	0

* Note: Additional terms used as locational referents

The results of this analysis provided background information which was used in developing simplified continental relief maps for North America, South America, Europe, Asia, Africa, and Australia. The frequency and use of the locational referents identified are consistent with those found in other inspections and analyses of social studies materials.

Task 10 Simplified continental relief maps

Project Personnel Frank Franks and Lawrence Butterfield, Jr.

Purpose

The objective of this project is the development of simplified continental relief maps for use as instructional aids in social studies for young blind students. Prominent geographical features provide reference points for introducing the study of the continents. Chromatic coding of water and land areas enhances introduction of these continents to young, low vision students.

Criticisms from educators in the field have prompted this development project. Criticisms of existing maps include:

(1) Existing maps include too much detail for introduction to young blind students.
(2) The relief is not sufficient to make maps high by discriminable tactually even if existing maps were made less detailed.
(3) No set of simplified relief maps exists for introducing the study of the continents to young blind students.

Inspections of existing maps, comments from social studies groups at national conventions, and reports from educators in the field support these criticisms.

Results of efforts to gather information which have been used in designing this project are summarized in the following paragraphs.

The Curriculum Branch of the Division of Instructional Services of the Los Angeles City Schools developed a "Sequence Chart of Map and Globe Skills and Understandings for Kindergarten through Grade Six," (Denoyer-Geppert, 1970). The Chart was prepared as an instructional aid for use in the study of geography and its interrelationship with other areas of social studies. The Chart emphasizes maps and globes as tools for teaching understanding of physical geography (the nature of the surface features of the earth) and of cultural geography (man's relationship to his environment).

Two purposes of the sequence chart are to:

(1) Provide a framework for teachers from which pupils may be guided to learn the language necessary for reading and interpreting maps and globes. This is achieved through participation in appropriate learning activities.
(2) Provide teachers with a developmental sequence of skills and understandings through defining broad skill areas. These increase in complexity from grade level to grade level.

The authors state that

> skills and understandings are grouped in the categories most consistently recognized by authorities in the teaching of maps and globes. They are arranged in a sequence which generally parallels the content of the social studies program. They are also organized by grade levels.

The reading of simple maps and globes, along with informal interpretative experiences, comprise the major emphasis in the primary grades. The sequence chart was examined to identify those skills and understandings related to continents. Table 1 summarizes skills and understandings involving the study of continents, Grades I - III.

Table 1

Sequence Chart Skills and Understandings on Continents

Grade I
Recognizes that friends and relatives live in various places in the community, state, nation, and other parts of the world.
Learns the name of the city, state, and country and locates them on a globe.
Locates places of vital current interest in the community, state, nation, and world on maps or globes.
Grade II
Recognizes his city, state, and country on a map or globe and understands that they are in a large land mass or continent called North America.
Use the globe and wall maps to locate areas in the news and to relate them to his community
Grade III
Understands the concept of continents as large masses of land and of oceans as large bodies of water; locates them on maps and globes
Locates places in relation to continents and bodies of water
Recognizes similarities between areas introduced on a globe and the same areas on a map
Learns to identify specific landmarks, such as an unusual coastline or other conspicuous natural feature, and uses the information to locate places on map or globe
Relates current happenings in the state, nation, and world to areas on maps and globes

Introductory social studies materials and textbooks generally have focused on the student in his home, his school, and his community. Recent series have occasionally expanded into Social Science programs and have introduced students to continents other than North America very early in these programs. A notable example is Concepts and Inquiry Social Science Program prepared by the Educational Research Council of America (Allyn and Bacon, 1970).

The overall objective of this program is stated as follows:

> The objective of Concepts and Inquiry is to expose young citizens to that body of knowledge and skills which will help them to make informed decisions as adults in matters affecting themselves in their social relations and in the political and economic affairs of their community, country, and world. The process of exposure is planned and cumulative; it takes place over the entire school career from primary or pre-primary to high school graduation. It is complicated and subtle, since the operation of a free, pluralistic society, such as the American People, calls for sensitive insights, delicate skills, and the ability to handle complex data and conflicting considerations.

Inspections of the contents of the program at the primary grade level revealed the need for early introduction of map study and the need for simplified continental maps for primary grade students.

Critical features which should appear on continental relief maps were identified in a curriculum analysis (Task 9). These features are included in the legibility evaluation of the maps in this study.

Field support and endorsement of appropriate introductory map reading materials for visually handicapped students came from the Science-Social Studies Workshop, Association for the Education of the Visually Handicapped (AEVH) Conference, held at New Orleans, 1970. A mock-up of a simplified continental relief map was presented at the AEVH Conference in Miami, 1972. Participants emphasized such materials are not available.

A consumer panel on Map Reading for Primary Grade Visually Handicapped Students met at APH, January 13-15, 1972, to review introductory map reading materials. The following suggestions and recommendations relevant to this project were made:

(1) A need for simplified continental relief maps exists. The APH Plaques are not adequate for use by younger (elementary) blind students.

(2) Indication of scale should be included on each map.

(3) Notation of scale differences in the various maps and other relevant information not on the map should appear in accompanying written materials.

(4) The group agreed that three colors would be desirable for coding water, land, and the higher mountain areas. An additional color on the highest mountain peaks for use by low vision students is suggested, if it does not substantially increase the cost of the set of maps.

(5) Neither longitude and latitude nor directional referents should be included on these nor any other introductory relief maps.

(6) The continental relief maps should be used in conjunction with the globe to teach location and direction.

(7) Use of the Landforms is suggested for teaching or reviewing specific geographical concepts which appear too small for clear inspection on the continental relief maps.

The purpose of this project is to develop simplified continental relief maps and to evaluate the appropriateness of these maps as instructional aids in social studies for young blind students.

Materials

The materials in this project (when completed) will consist of simplified continental relief maps of North America, South America, Europe, Asia, Africa, and Australia. The maps will be no more than 20 x 24 inches, will be produced on 15 mil high impact styrene with a maximum rise of 1 1/4 inches, and will be color coded in three APH standard colors--blue, light yellow, and green--to facilitate use by low vision students.

Procedure

A study was made to evaluate the legibility of prominent geographical features on a simplified continental relief map (North America) as a guide to the development of the continental relief maps of South America, Europe, Asia, Africa, and Australia.

A total of 44 braille students from grades three through five in the Tennessee, the Arkansas, and the Maryland schools for the blind were used in testing the map. Students were selected from regular classes and were classified in school records as braille readers. Those students who were able to utilize residual vision were asked to use sleep shades during the presentation of the testing program.

A simplified continental relief map of North America (approximately 19 x 23 inches) was tested. The vacuum formed relief map was produced on 15 mil high impact styrene with a maximum of 1 1/4 inches rise allowed for the highest mountains. The map is chromatically coded in three APH standard colors--blue, light yellow, and green. Exaggeration of some critical continental features (e.g. Great Lakes, Mississippi River) was necessary to facilitate their location.

A criterion of acceptance of 80% performance was set for identification of each geographical feature. They were divided into older and younger groups for comparison of performance by each group. Eight of the nine geographical features met the criterion for acceptance. River did not reach criterion for either group.

Subjects were tested individually. These procedural steps were followed in presenting the evaluation program:

(1) Training program: A small landform showing each geographical feature was presented. The definition for each feature was read (twice) as the subject examined the landform.

(2) Training program review: The subject was asked to find the geographical feature on a composite map using each small landform. The definition for each feature was read twice.

(3) Test: The subject was given the continental relief map of North America and was asked to find each feature as the definition for each feature was read. Each small landform was again presented for use as a cue card.

Although eight of the nine prominent geographical features met the criterion for acceptance, it was decided to have the simplified map reviewed by a geographer who would evaluate the map regarding further exaggeration or repression of geographical features for greater legibility. The geographer evaluated the map and concluded that further exaggeration or repression could be made with certain features without distorting the map too much for use as an introductory map aid for young students. (e.g. The mountains can be further repressed leaving only the Rocky Mountain range along the western side of the United States and the Appalachian Mountains on the eastern side. The Mississippi River Valley can be further incised and widened to show the location of the Mississippi River. Greater space can be allowed between islands and the adjacent coastline. The area representing the Great Plains--and other plain areas--can be better discriminated as "plains" with smoother, more level surfaces.)

The "river" item (70% performance for each group) which is an incised groove is the only geographical feature which did not reach the criterion of 80%. The Mississippi River represents a critical geographical feature in the study and development of eastern America, consequently, a decision was made to include it. The groove showing the location of the river was further exaggerated and special reference will be made to the river and its identification in the brochure and materials accompanying the map.

Results Expected

The development of a map reading program with appropriate educational materials will enable teachers to introduce map reading concepts to young visually handicapped students at the same time and grade levels as their sighted peers receive the instruction. At present, visually handicapped students at the primary grade level receive little or no instruction in map reading because appropriate materials for this instruction do not exist. The availability of these materials through APH, on federal quota, should stimulate the early introduction of map reading to visually handicapped students in residential and public school programs throughout the country. Implications are for improved map reading instruction in educational programs for these students nationally and for the development of more tactually discriminable maps at APH in future years.

Task 11 Maps in the classroom

Project Personnel Frank Franks

Purpose

The lack of geographical knowledge and map reading skills by blind students frustrated attempts by Nolan and Morris (1971) to develop a pilot program in map reading training. The lack of information in tactual perception, the lack of training and experience in map reading, and the lack of skill in map reading techniques were reviewed by these authors. They suggested that the best place to begin research in map reading is at the conceptual level. They stated that once concepts of orientation and geographic features of the earth are learned, the student can be taught reading techniques and maps can be tested.

Sabaroff (1957) states that the overall objective for the primary grades is to help develop a geographic point of view; a better understanding of the relation of man to his environment. She lists the following four objectives as basic to accurate map interpretations:

(1) Ability to observe thoughtfully; development of a spirit of inquiry, purposeful exploration of the common, everyday conditions of the immediate environment.

(2) Ability to reason about things geographic; development of the child's potential to understand the behavior of people within his zone of contact (community) in terms of the conditions, both natural and cultural, in which he observes them.

(3) Ability to reorganize the "raw material" gained in observation and present in some map form; from three-dimensional, crude, very simple relations in space to increasingly more refined and more accurate representations.

(4) Ability to read through the symbols of maps of the immediate environment made by others to the landscape and realities they represent and then to understand some of the simplest, most direct relationships thus revealed.

A consumer panel on Map Reading for Primary Grade Visually Handicapped Students met at APH, January 13-15, 1972, to review introductory map reading materials. The following recommendation was made:

> It is imperative that the personal aspects in the development of the visually handicapped student parallel those of his academic development. The members of the group recommend that upon completion and evaluation of this map reading project (Task 7), the program again be reviewed for purposes of incorporating a personal dimension within the program. This personal dimension would apply the basic concepts presented in the instructional program and would facilitate interaction of the student with his environment. Where appropriate, activities involving the personal dimension should parallel map activities, and should be presented as part of a comprehensive program built upon relating these concepts to maps.

> The program would incorporate activities that are necessary for the student to function in his environment and these activities would be directly correlated with map reading readiness and exploration of the environment.

The purpose of this project is to develop materials which include the personal dimension as recommended. The goal of the project will be to develop and evaluate a program to teach blind students that known environments can be represented abstractly on simple maps.

Materials

The instructional program consists of 80 lessons with tangible aids (e.g. models of chairs and tables, simple maps) and progresses from manipulation of concrete objects in a known environment to discrimination of symbolized objects on simple maps. Initially, the student learns 20 fundamental locational and directional referents using common objects (e.g. chairs, tables) in the environment. Finally, he uses simple maps and the referents he has learned, to locate objects in the known environment (concrete to the abstract--abstract to the concrete). The 80 lessons will be divided into two sections of 40 lessons each.

Procedure

An initial draft of the program was completed and reviewed by an APH advisory committee. Revisions in the program, as indicated by this review, were made. Subsequently, the program was sent for review to primary teachers in five residential school programs and one public school program. The teachers were encouraged to use the program with children as part of the review process.

A conference of the reviewers was held at the Tennessee School for the Blind, Nashville, January 24-26, 1974 for the purpose of assessing the content and appropriateness of the materials. The lessons were individually reviewed and changes recommended where necessary. Writing of additional lessons to fill gaps in the program was also recommended. Rewriting on the program was completed when the IMRC grant was terminated.

Results

A second draft of an instructional program to teach visually impaired students that known environments can be represented abstractly on simple maps was completed. Future plans call for completion of development of the program and evaluation of its effectiveness in the field.

Task 12 Individualized auditory instructions for landforms

Project Personnel Jack Miller

Purpose

Retardation in geographic knowledge poses a common and serious problem for blind and visually handicapped students. Low performance in map reading tasks was demonstrated by Hayes as early as 1937 and again in Task 2. Much of the difficulty seems to reside in lack of appropriate teaching materials and procedures. In 1970, the IMRC developed the set of Landform Models (Task 4) previously described in this chapter to partially fill this lack. These models are designed to present 40 common geographical concepts. A criterion test to accompany the materials was also developed. As originally designed these instructional materials require extensive teacher-pupil interaction, yet they appear quite suitable for individualized instructions.

The purpose of this project is to develop auditory materials in cassette form which will enable the Landforms to be used independently by individual students or small groups of students.

Procedure

The audio tapes were developed in a collaborative effort between IMRC personnel and a group of developers at George Peabody College for Teachers led by Dr. Jack Miller. Specifications for the materials were drawn up by the Peabody group and reviewed by IMRC personnel. It was ultimately determined that 11 tapes should be developed presenting concepts as broken down in Table 1.

Table 1: Summary of "Doobie" Tapes

Tape	Concepts	APH Landform Map
1	Land Water	0
2	Ocean Island Lake Seashore (coast, coastline) Beach	I
3	Hill Mountain Valley Canyon Reservoir	II
4	Basin Plain Plateau	III
5	Review of tapes 1-4 content	None
6	Channel Canal Gulf Bay	IV
7	River Source of a river Mouth of a river	V
8	Review of tapes 6-7 content	None
9	Volcano Mountain Peak Range of Mountains Highland Foothills Divide Timberline	VI
10	Peninsula Cape Isthmus Strait Sound Inlet Dike	VII
11	General Review	None

As individual tapes were developed they were reviewed by IMRC personnel. If required, the tapes were revised. They were next pilot tested with students in the elementary grades at the Tennessee School for the Blind, Kentucky School for the Blind, and public and private schools in Nashville. During the pilot tests observations were made (1) as to whether the tapes were effective teaching aids when used with the landforms and (2) whether they were interesting and motivating enough to hold the attention of visually handicapped children in the 9-13 year age range. Tapes were reviewed and revised on the bases of teachers' reports generated during the pilot study.

Materials

An attempt was made to define each concept as clearly as possible verbally to the child and to coordinate this definition with tactual exposure to the concept on the APH Landforms. In this approach, the tape talks to the student as he uses the Landform telling how it should be oriented, where to place his hands, and then describing what should be felt as the geographical phenomena are located on the map.

The conceptual message could be very dull and, consequently, result in children rapidly losing interest. Therefore, the conceptual message is mixed with a carrier wave of music, humor, and rapid changes of pace. This approach is similar to that developed by Childrens' Television Workshop in designing Sesame Street and Electric Company. Research by the Workshop had shown that children rapidly become inattentive as video-audio segments extend beyond 45-90 seconds. These findings served as a guide in development of the tapes.

The 11 tape series carries the title "Blank Tape Mystery Computer Special." The main character, "Doobie the Brain," is a computer that has learned to think for himself and used this ability to confound his owners. The conceptual message on the tapes is blended with humor and music. A series of characters is developed, some adult and some children, who are roughly equivalent to those seen on Saturday morning TV, Sesame Street, or Electric Company. As in situation comedy, many of the characters are not trying to be funny. On the contrary, they take themselves very seriously as they explain scientific facts in mixed syntax or respond to their teacher in "Mr. K's classroom." Some, like Doobie the mischievous computer, who sends out supposedly blank tapes with messages, or Rhymer and Giggler, who sing or recite poetry about a world they enjoy, merely represent blythe spirits in a world that tries to take itself too seriously. In a sense, perhaps, they represent the children who are listening. Music on the tapes is used for bridging one short segment or audio tableau to the next and as a series of themes to identify the characters.

Results

Eleven tapes of 13-14 minutes duration have been designed and recorded. These tapes have been formatively evaluated by experts and through use with children. Reactions of students have been uniformly positive. Children seem to identify with the characters and regard listening to the tapes as an activity of their own rather than as an activity imposed upon them by teachers and adults. Learning appears to proceed very effectively. Termination of the IMRC grant occurred at this point of development. However, it is planned to complete development and evaluation of these materials.

CHAPTER EIGHT

DEVELOPMENT OF SENSORIMOTOR READINESS AIDS

These activities were initiated as a consequence of efforts to write a booklet describing developmental problems of pre-school visually impaired students. A group brought in to APH to review a draft of the booklet strongly urged the development of a series of sensorimotor readiness aids for these children. Before this was attempted, a survey of commercial materials was made to avoid duplication of already available materials. Subsequently, models of seventeen sensorimotor aids were developed. Eight of these were accepted by a review panel and put into production by APH. The remaining nine were subjected to field trials. Three of these were later accepted and submitted to APH for production. The remaining six were rejected.

Task 1 Booklet on the development of the visually impaired child at the pre-school level

Project Personnel Carol Halliday

Purpose

The booklet was designed for teachers, other professional workers, and parents of visually impaired children of pre-school age. It is meant to be of practical value with regard to the care, training, and instruction of the child from birth until entry into a formal school program.

Procedure

The approach in writing the booklet was eclectic in that an attempt was made to bring together and integrate the current thinking of leaders in the fields of child development and visual impairment. A bibliography of 164 entries was compiled.

Sixteen visits were made to different kinds of children's programs. These included those serving normal children, perceptually handicapped children, culturally disadvantaged, and visually impaired. Particularly fruitful visits and staff conferences occurred at the Demonstration and Research Center for Early Education, George Peabody College, Nashville, Tennessee; the New Nursery School Research Project, Colorado State College, Greeley, Colorado; the Utah School for the Blind, Ogden; the Texas School for the Blind, Austin; two Project Head Start Styles classes, the Department of Psychology, University of Louisville, Louisville, Kentucky; and the Delta Gamma Foundation for Visually Handicapped Children of St. Louis, Missouri.

The following persons were invited to a three-day workshop for the purpose of determining guidelines for the development of the booklet:

Barbara Dorward, Teacher of Emotionally Disturbed Children, Atlanta Public Schools, Georgia
Mrs. Kay Horton, Chief - Language Development Division, Bill Wilkerson Hearing and Speech Center, Nashville, Tennessee
Mrs. Ina Kurzhals, Instructional Supervisor, Utah School for the Blind
Bob Winn, Director, Program for Multiple-Handicapped Children, Texas School for the Blind
Mrs. Betty Wommack, Instructional Supervisor, Kentucky School for the Blind

A draft of the booklet and guidelines for review was sent to this committee prior to the workshop.

Drafts of the booklet were sent to additional reviewers. Chief among those who gave time and effort to reading, constructively criticizing, and suggesting improvement were: Dr. Natalie Barraga, Mrs. Dorothy Bryan, Miss Freda Henderson, Mrs. Ina Kurzhals, and Dr. Carson

Nolan. More than ten other professionals gave specific aid. Mrs. Amie L. Dennison and Dr. Gloria J. Roddey served as editors in the final revision and publication procedures.

Results

The booklet, "The Visually Impaired Child: Growth, Learning, Development, Infancy to School Age" by Carol Halliday was published in March 1970 under the auspices of the IMRC. The booklet specifically:

1) Describes the visually impaired child in terms of basic needs shared with all children and relates his specific needs to his particular characteristics and ways of functioning, one aspect of which is his visual impairment.
2) Presents in outline form, certain developmental sequences through which children normally pass prior to admission into a formal school program.
3) Discusses in specific terms the special help needed by visually impaired children to circumvent or minimize their visual problems while developing more completely and capably other means of learning and living.
4) Lists and describes educational materials especially suited for the visually impaired child as he develops and learns.
5) Names and identifies salient agencies, programs, and services providing information or aid for the young visually impaired child and provides a bibliography of pertinent books and related resource materials.

Task 2 Review panel: The pre-school visually impaired child. March 17 - 19, 1969.

Project Leader Carol Halliday

Purpose

A three-day meeting was held at APH for the purpose of:

1. reviewing a draft of a brochure written for parents of pre-school visually impaired children.
2. identifying materials needs, defining materials specifications, and assigning developmental priorities.

Participants

Barbara Dorward, Teacher of Emotionally Disturbed Children, Atlanta Public Schools, Georgia
Mrs. Kay Horton, Chief - Language Development Division, Bill Wilkerson Hearing and Speech Center, Nashville, Tennessee
Mrs. Ina Kurzhals, Instructional Supervisor, Utah School for the Blind
Bob Winn, Director, Program for Multiple-Handicapped Children, Texas School for the Blind
Carol Halliday, Staff, IMRC, American Printing House for the Blind
Ken Coy, Staff, IMRC, American Printing House for the Blind

Results

A draft of the parent brochure was sent in advance to all participants. The following points were made by the review panel and other reviewers concerning the development of this book.

1. In the developmental sequence section, it is recommended that there be three columns, rather than two. The first should describe the normal child, the second the visually impaired child, the third should specify activities which parents can do with their visually impaired youngster.
2. It was urged that these sequences be listed rather than strung out horizontally.
3. A "letter from a parent" is recommended as a beginner for the booklet.
4. Illustrations are needed.
5. Separate booklets would be appropriate eventually on the developmental activities in each of the booklet's four major areas.
6. A simple everyday kind of field trip such as a walk could be described in detail as a model for other such activities.
7. A set of descriptions of routine days could be included, perhaps at six month intervals, which would describe the daily activities of the mother and the ways in which she meaningfully would involve her visually impaired child.
8. The booklet should be turned sidewise so all writing goes in the same direction.

9. Use of residual vision and training of visual discrimination should be stressed.
10. It should be emphasized that the child needs to have visually observable behavior and feelings of others explained to him.
11. In the future, slides with script and tapes could be used in addition to printed materials.
12. The four major developmental areas should be divided into subheadings.

The following suggestions were made as guidelines in materials development for the pre-school child:

1. The major concern should be for the child functioning on the 3 to 5 year level.
2. Materials development should be approached from the point of view of the problem areas observed in children when they first come to school. Chief among these are auditory training, visual training, development of hand use, and self-care.
3. It was stressed that materials should be developed which children can use on their own. These materials should have built-in motivators which give them interest and encourage further use and exploration by the users.
4. Three groups of priority materials were defined:

> The top priorities included a set of texture blocks, varied on a number of dimensions; a "sound sorting box" containing three openings, each with a distinct sound which will occur as objects are sorted into the openings; a tray to be used as a work space; a small constructo set (simply a curtailed version of the larger one already made by APH); and a greatly enlarged button/buttonhole and belt/buckle for the teaching of related self-care skills in the most gross, easily understood way possible.
>
> The second priorities recommended were sound cylinders with screw-on tops, whose contents can be infinitely varied; a "light peg and shape board" which would utilize translucent pegs, illuminated (varying intensities possible) from beneath, and would allow the formation of light patterns with regard to visual training; and a peg wagon which the young child could pull and which would allow taking out and putting in pegs on a gross scale.
>
> The third priorities included a take-apart doll; large textured beads; a pair of hands, in a form-board setting, which would be a good first step to the hands in Touch and Tell; a "tilt box" involving a ball on a track which would encourage movement-experimentation with changing auditory results; and a double pegboard, with "placing in" possible on one side, "screwing in" on the other, and varying shaped heads on the pegs for further developmental use.
>
> The other materials which were discussed as of value but were listed only to follow those previous include: 3-dimensional

geometric puzzles; fixed-furniture doll house (peg-in idea); elementary map kit (room at home, classroom, etc.); location puzzle (house, trees, people symbolized); audible ball (which will sound, constantly); large easy opening zipper; hook-together train; shoe lacer, to be stepped into; dominoes with actual objects on them; constructo kit, with pieces smaller than those in present APH kit; ball and simple inclined plane; marble on ramps (ball and ramps of different textures); large blocks (18" x 18" and others 18" x 18" x 36"), whose surfaces would somehow grip for stacking; "big and little" board which would contain two of several shapes; and a "sound platform" which could be put in the young child's play tray.

5. A descriptive leaflet should be written for each materials developed. This leaflet should discuss the materials purpose, how it might be used, the child's functioning level for which it is most suited and how to encourage the user's creative use of the material.

Task 3 Survey of available materials for elementary readiness

Project Personnel Fay Leach

Purpose

This survey was for the purpose of developing an indexed listing of currently available materials for basic readiness skills focusing on multi-handicapped and/or students who function on a preschool level.

Procedure

The survey involved three methods: 1) development of a catalogue file and review of commercial catalogues, 2) visits with teachers to review elementary materials being used, and 3) review of materials displays at educational conventions.

Results

An 87-page listing was printed and distributed through the IMRC. This listing served as a resource material in the needs analysis and development of educational materials.

Task 4 Development of pre-school readiness materials

Project Personnel Carol Halliday and Kendrick Coy

Purpose

Teachers and parents of young visually handicapped children have repeatedly expressed a need for materials whose use in homes and schools would create readiness for learning reading and arithmetic among blind children. The purpose of this project was to define needs and to develop specifications for materials development.

Procedure

Visits were made to pre-school programs throughout the country. On the basis of these visits developmental descriptions of materials suggestions were drafted. These descriptions were sent to a number of experienced personnel for criticism. Selected professionals attended a three-day workshop at APH (Task 2). Needed materials were identified, their specifications defined, and priorities for development were assigned. Models of the items were built. These models were then evaluated by members of the workshop group and recommended for production or additional review and development.

Review Personnel

Barbara Dorward, Teacher of Emotionally Disturbed Children, Atlanta Public Schools, Georgia

Mrs. Kay Horton, Chief - Language Development Division, Bill Wilkerson Hearing and Speech Center, Nashville, Tennessee

Mrs. Ina Kurzhals, Instructional Supervisor, Utah School for the Blind

Bob Winn, Director, Program for Multiple-Handicapped Children, Texas School for the Blind

Mrs. Betty Wommack, Instructional Supervisor, Kentucky School for the Blind

Materials

Models of the following items were built and reviewed by the group:

(a) Textured blocks--these consist of 36 blocks of three sizes, six colors, and six textures for the purpose of developing tactual awareness and ability to discriminate along the dimensions portrayed.

(b) Giant textured beads--these consist of 18 beads of three shapes, three textures, and three colors for the purpose of teaching differentiation of shape and to introduce the child to bead stringing on a gross level.

(c) Take-apart doll--consists of 15-inch wooden doll whose head, arms, hands, legs, and feet can come off. The doll serves as a means of teaching body parts and their relations and as a large puzzle.

(d) Work-play tray--a wooden tray 13.5 x 22.5 inches with a 1-inch raised edge to supply a confined area within which the child can work and play with small objects.

(e) Sound discrimination cylinder--a small brightly painted hollow cylinder with a handle and a screw lid that allows cylinder contents to be varied. Its purpose is to serve as a variable sounding rattle to teach sound discrimination and to teach basic manipulative skill.

(f) Shape board--a standing rectangular board with five rows of three hooks each and a variety of plain figures of different shapes, sizes, colors, and textures that can be hung on the hooks. The purpose is to give the child an opportunity to discriminate and sort the figures along the several dimensions.

(g) Puzzle formboards--consist of five formboards: a diamond, a square, a circle, a triangle, and a rectangle. Pieces are represented as whole forms and as divided into two and three parts. The purpose is to let the child learn whole forms and then learn to work a puzzle of the parts.

(h) Peg wagon--a small wooden wagon with a handle with horizontal insets for the bed containing holes of different numbers and sizes with pegs to fit the holes. Can be used first as a wagon and later as a peg board.

(i) Junior constructo set--consists of a smaller number of pieces from the regular APH Constructo Set that the child can use for manipulation of bolts and nuts and assembly.

(j) Formboard with removable hands--a board with left and right "hands" cut-outs with wooden hand inserts that can be used as a simple formboard to introduce the idea of hands and handedness and to introduce the idea of color.

(k) Button aid--consists of two sizes of an exaggerated button and buttonhole for the purpose of demonstrating and giving practice in the bottoning process.

(l) Belt and buckle--an exaggerated belt and buckle for the purpose of demonstrating what is involved in buckling.

(m) Shoe lace and large wooden shoe with lacing capability in which a child can place his foot.

Summary

The giant textured beads, work-play tray, sound discrimination cylinder, shape board, puzzle formboards, junior constructo set, handform board, and the shoe lace and shoe were produced by APH. Pictures and descriptions of these materials can be found in the brochures included in Appendix B. The other items were recommended for further development and evaluation.

Task 5 Evaluation of textured blocks

Project Personnel Fay Leach and Kendrick Coy

Purpose

The purpose of this task was to further develop and evaluate a set of textured blocks designed as a sensorimotor readiness aid.

Procedure

A prototype was developed from specifications outlined in Task 4. Models were placed in three schools for a 2-month evaluation by teachers. Each teacher was requested to complete a prepared evaluation form.

Materials description

The textured block set consists of 36 blocks of three sizes, six colors, and six textures for the purpose of developing tactual awareness and ability to discriminate along the dimensions portrayed.

Participants

The following schools participated in the field test:

California School for the Blind, Berkeley, California
Georgia Center for Multi-handicapped Deaf Blind Children, Atlanta, Georgia
Utah School for the Blind, Ogden, Utah

Results

Five teachers completed an evaluation form for the textured blocks. Three of the five recommended this as an aid which should be produced by APH. The adherence and permanence of the textures was questioned by three of the teachers. There was disagreement concerning the most desirable sizes for the blocks. Two teachers indicated that they felt too many variables were presented to the child at one time. All five teachers indicated that manipulation features were good. Three responded positively to the colors used. However, dyes used in the textures came off on children's hands and faces.

Conclusion

Due to problems in adhering textures to the blocks, running of dyes in textures, and lack of agreement among evaluators, it was decided to discontinue development of these materials.

Task 6 Development of a pre-school peg wagon

Project Personnel Fay Leach and Kendrick Coy

Purpose

The purpose of this project was to further develop and evaluate the peg wagon as recommended by the review panel.

Procedure

A prototype was developed from specifications developed by the review panel and IMRC staff. The prototype was submitted to APH inhouse review. Models were placed for pilot evaluation. Initial evaluation forms were completed.

Materials

The progressive peg wagon is a small wooden wagon with a handle. The horizontal insets for the wagon bed contain holes of different numbers and sizes with pegs to fit the holes. The wagon is designed to be used first as a wagon and later as a peg board.

Reviewers

Persons assisting in the initial evaluation included:

Dr. Edward Berla', Research Scientist, American Printing House for the Blind, Louisville, Kentucky

Mrs. Cornelia Hartough, primary teacher, Kentucky School for the Blind, Louisville, Kentucky

Mrs. Ina Kurzhals, Curriculum Director, Utah School for the Blind, Ogden, Utah

Mrs. Betty Wommack, Instructional Supervisor, Kentucky School for the Blind, Louisville, Kentucky

Each person observed children using the prototype.

Results

The initial evaluations of the prototype indicated that at least eight functional or safety features needed substantial changes. Cost estimates of production were higher than wooden wagons currently available on the market. A question was raised by those persons evaluating the wagon as to the use of a moving item such as a wagon for a stationary object, a board for fitting pegs into holes.

Summary

It was decided that commercially available wooden wagons would serve the purpose outlined in the specification for this aid at a more economical cost. The features of the peg board were incorporated in the First Peg Set which was developed at a later time (Task 12).

Task 7 Development of elementary dressing aids

Project Personnel Fay Leach and Kendrick Coy

Purpose

The purpose of this project was to develop and evaluate materials to teach young children to button and to buckle a belt.

Procedure

Prototype models were placed in the hands of five teachers of elementary and/or multihandicapped visually impaired children for a six-month field test. An evaluation form was developed for each aid. At the end of the field test period, each teacher completed an evaluation form on each aid. Suggestions for use accompanied the prototypes.

Materials

The belt and buckle aid consists of an enlarged belt and buckle for the purpose of demonstrating what is involved in buckling. The large buckle is designed so that the child can actually reach his hand through the buckle to grasp the end of the belt. Three prototypes were submitted for testing (model A with a large wooden buckle, model B with a medium sized buckle, and model C with a metal buckle with roller guides.) Model C was commercially available.

The button aid consists of two sizes of an enlarged button and buttonhole for the purpose of demonstratnng and giving practice in the buttoning process. Two prototypes were tested (model A was mounted on frames with a belt to use for wearing and model B was a folder style.)

Reviewers

Five teachers from the California School for the Blind used the prototypes with elementary and multihandicapped visually impaired students.

Results

Eighty percent of the respondents ranked the enlarged buckle and belt aid as awkward, too big, and too wide. Eighty percent indicated that commercially available belts were superior than the prototypes tested.

Model A of the button aid was ranked by 100 percent of the respondents as being preferred over Model B. Model B was the aid which had been recommended for consideration for development. Respondents indicated that some of the children who had success with 1/2-inch buttons had difficulty with the 3-inch button. Sixty percent of the respondents found regular items of clothing superior for teaching buttoning skills. Eighty percent of the respondents indicated that model A with improvements should be recommended for production by APH; however, only one teacher found it to be a significant aid in teaching buttoning skills.

Summary

The field trial did not support the assumption that enlarged buttons and belt/buckle aids greatly facilitate the teaching of these dressing skills. As a result, work on these aids was discontinued.

Task 8 Development of the directional concepts board

Project Personnel Fay Leach and Kendrick Coy

Purpose

The purpose of this task was to develop and evaluate a directional concepts board as a readiness device for pre-school children.

Procedure

Models of the directional concepts board were developed and placed in four programs. Follow-up visits were made to three of these programs to discuss the models with teachers who used them in the three-month field test. Instructions for use accompanied the models. Each teacher was requested to complete a prepared evaluation form.

Reviewers

The following programs participated in the field test:

California School for the Blind, Berkeley, California
Georgia Academy for the Blind, Macon, Georgia
Georgia Center for Multi-handicapped Deaf Blind Children, Atlanta, Georgia
Unit for Blind Multi-handicapped Children, Murdoch Center, Butner, North Carolina

Materials

This item is a board with two knobs which can be moved across the plane of the board in horizontal and vertical directions. One knob has a pressure plate which requires the child to exert a degree of strength in making the required movement. The item is best used in individual work with the child.

The basic purpose of the board is to aid in teaching a number of simple directional concepts. These include:

Top-bottom
Up-down
Left-right
Push-pull

The board is also designed with the purpose of helping to develop gross hand movements especially for a child who has poor hand usage.

Results

Nine teachers completed evaluations on the directional concepts board. Eight (89 percent) recommended this aid for production by APH. Questions were raised concerning the ease of manipulation and durability of the device. These suggestions for improvement were made:

a. This needs to be more durable. It is difficult to manipulate. The handle comes off.
b. There should be an indicator at the midpoint.
c. Handles should be painted to contrast with the board.
d. A variety of handles should be used to fit on one screw.
e. Add sound.
f. Make a series of shape devices.
g. The edges should be beveled.
h. It is too difficult for a number of students using it.
i. An open back board would be better.

Conclusion

Subsequent to the field trial of this device, a commercial producer of educational materials started distribution of a device whose specifications were almost identical. Consequently, development of the IMRC version was halted.

Task 9 Development of the large textured block

Project Personnel Fay Leach and Kendrick Coy

Purpose

The purpose of this task was to develop a large textured block and evaluate its usefulness as a sensorimotor readiness aid.

Procedure

Models of the block were developed and placed in four programs. Follow-up visits were made to three of these programs to discuss the models with teachers who used these in the three-month field test. Instructions for use accompanied the models. Each teacher was requested to complete a prepared evaluation form.

Reviewers

The following programs participated in the field test:

California School for the Blind, Berkeley, California
Georgia Academy for the Blind, Macon, Georgia
Georgia Center for Multi-handicapped Deaf Blind Children, Atlanta, Georgia
Unit for Blind Multi-handicapped Children, Murdoch Center, Butner, North Carolina

Materials

Each block unit consists of:

one 3-inch cube with sides of four colors (red, yellow, blue, and white) and four textures (raised parallel lines, grid, raised dots and smooth)

one frame

six 3" x 3" plane insets which are duplications of each side of the cube.

This large block is designed with different colors and textures on each side and with a frame into which the block can be fitted. The frame is designed with a homing principle so that a very young child or a child with multiple handicaps can fit the block into it with very little difficulty. Accompanying the frame and block are squares of materials of different colors and textures which can be matched with the sides of the blocks. The block and frame can be used alone or several can be used together to form patterns which the child can duplicate or develop from memory.

Results

All seven teachers evaluating this aid recommended that it be considered for production by APH. Suggestions for improvement were:

a. Each set should have a minimum of three blocks and frames to allow for matching and sorting tasks.
b. The frame inset needs to be deeper.
c. Corners on the blocks should be rounded to avoid sharp edges.
d. Add a third texture made of braille dots. Each block should have three textures and 3 colors.
e. Paint on frames and textures did not adhere well.
f. Do not paint the textures.
g. The tacmer proved poor, it lost its adhesive quality. Use a friction pad.
h. There was too much stimulation in the color for a perceptionally handicapped child. Some teachers did like the color.
i. There needs to be a storage unit. (This could be the packing box.)

Summary

Suggestions for improvement were incorporated into the design of a model which was produced by APH. This device is pictured and described in a brochure contained in Appendix B.

Task 10 Development of a take-apart doll

Project Personnel Don Walker and Kendrick Coy

Purpose

The purpose of this project was to develop a take-apart doll and assess its usefulness to teach bodily parts to kindergarten level students.

Procedure

Several models of dolls were developed and one was selected for evaluation by an APH review committee. A training program to teach bodily parts and their relations was developed consisting of 20 sessions each of 15 minutes duration (Walker, 1971).

Ten kindergarten teachers in eight residential schools were trained in use of the program and used it over a four week period. Forty blind kindergarten students participated in the study, half receiving training and the other half serving as controls. Students were tested before and after training with the Body Image Screening Test.

Comments from the 10 teachers involved in the training program were elicited in unstructured interviews conducted on the day post-testing was done in their respective schools. Each teacher previously had been asked to take notes during the course of the training program and to be prepared to comment on the lessons and on the doll. They were told that their comments would be used in revisions of the lesson guide and modification of the doll.

Materials

The take-apart doll consists of a 15 inch wooden doll whose head, arms, hands, legs, and feet can come off. The doll serves as a means of teaching body parts, and their relation, and as a large puzzle.

Subjects

Forty students from eight residential schools for the blind were randomly divided into two groups, experimental and control. The schools participating were:

Georgia Academy for the Blind, Macon, Georgia
Kentucky School for the Blind, Louisville, Kentucky
Maryland School for the Blind, Baltimore, Maryland
New York State School for the Blind, Batavia, New York
The Governor Morehead School, Raleigh, North Carolina
Ohio State School for the Blind, Columbus, Ohio
Virginia School for the Deaf and the Blind, Staunton, Virginia
Wisconsin School for the Visually Handicapped, Janesville, Wisconsin

Results

Of the 10 instructors participating in the program, five indicated that they thought the doll was of definite value as a teaching aid, two felt that it was useful but not really necessary, and three indicated that the doll was of little or no value to the teaching of body image.

The specific models employed in the training program exhibited so many defects in design that the doll needed a complete redesign before further use of it was made. Most of the critical comments regarding the prototype models had to do with quality of construction. The most frequently voiced complaint was that the joints at which the doll was supposed to come apart were poorly fitted, making the doll difficult for a child to assemble, and at times causing parts to fall off during manipulation. The head was particularly annoying and distracting, having been sculptured of a rather dense clay substance which was much heavier than the wood torso and limbs. The weight of the head, combined with the insecure fit of the head to the torso, caused it to fall off frequently during the training.

It was concluded that the highly structured program of individualized training in body image was an effective means of teaching. The training appeared to be most effective for use with children without useful vision whose IQ scores were below 80. The dissectable doll, when used with the structured training program, appeared to be a useful aid.

Concluding Statement

Additional work was to be done with the body image program at the Virginia School for the Deaf and Blind. From this a report of exact specification for a revised doll was to be developed. Further development was delayed until this report is available.

Task 11 Development of the peg frames

Project Personnel Fay Leach and Kendrick Coy

Purpose

The purpose of this project was to develop the peg frames and evaluate them as a sensorimotor readiness aid.

Procedure

Models of the Peg Frames were developed and placed in four programs. Follow-up visits were made to three of these programs to discuss the models with teachers who used these in the 3-month field trial. Instructions for use accompanied the models. Each teacher was requested to complete an evaluation form.

Participants

The following programs participated in the field test:

California School for the Blind, Berkeley, California
Georgia Academy for the Blind, Macon, Georgia
Georgia Center for Multi-handicapped Deaf Blind Children, Atlanta, Georgia
Unit for Blind Multi-handicapped Children, Murdoch Center, Butner, North Carolina

Materials

The peg frames consist of three frames of varying sizes which have holes of varying sizes. The first frame has one large hole, the next has two smaller holes, and the third has three holes which are even smaller. The pegs which accompany the frames are of varying sizes also in order to fit the different-sized holes. These pegs have enlarged tops so that they can be grasped more easily by children who might have difficulty with muscular control. Each of the frames is backed with materials which causes it to adhere to any surface. Therefore, the frames stay in place while the child manipulates the pegs.

Results

Nine teachers evaluated the peg frames. All respondents (100 percent) recommended this as an aid which should be produced by APH. Suggestions for improvement included:

a. These should be made available in both natural wood and color. The natural wood set should have the peg of one color with the hole painted the same color.

b. The tacmer lost its adhesive quality. It was suggested that another type of friction pad such as crepe rubber be used on the bottom.

c. The knob must be strong enough to receive some abuse. The thin knob on the 1-unit peg broke on two of the test sets.

d. It was suggested that the kit be developed into a 5-unit kit. (The frame with three should be in a single line.)

e. Each frame needs to be large enough to give the child room to grasp.

f. The holes must not be too close as in the 3-hole frame. The holes should be slightly larger than the pegs.

g. The color needs to be improved. It did not adhere and scratched off easily. It came off when a child put it into his mouth.

h. Some type of unit for storage and moving needs to be developed.

Summary

Features in this model were incorporated into the first peg kit which is discussed in Task 12 which follows.

Task 12 Development of the first peg kit

Project Personnel Fay Leach and Kendrick Coy

Purpose

The purpose of this project was to apply the results of Task 11 in development of a modified peg board.

Procedure

Test models were placed in eight programs for students functioning at the primary, pre-school and/or multi-handicapped level. Evaluation forms were developed. Suggestions for use accompanied the test models. Teachers were to use the peg it with students for a 2-month period.

Materials

Each kit contains:

one 8 1/4" x 5 1/2" x 2 7/8" wooden work and storage box
six inset frames
three 1 7/8" pegs
six 1" pegs

The pegs in the kit vary according to size, color, and are tactually different. There are two sizes of pegs. The colors used are red, yellow, and blue. Each peg has either one, two, or three grooves. Six black inset frames with holes of varying sizes and number can be placed into the black wooden box; this provides structure for matching, sorting, and manipulating the pegs. The kit was so designed that no two features of the pegs can be matched simultaneously.

Participants

Programs receiving test models were:

Program for the Visually Impaired and Multi-handicapped, DeKalb County School System, Scottdale, Georgia
Georgia Center for the Multi-handicapped, Atlanta, Georgia
Eastern Illinois Area Special Education Program, Mattoon, Illinois
Arlington Hospital and School Multi-sensory Handicapped Program, Arlington, Tennessee
Boston Center for Blind Children, Boston, Massachusetts
Governor Morehead School, Raleigh, North Carolina
Child Study Center, Oklahoma University Medical School, Oklahoma City, Oklahoma
Upsal Day School for Blind Children, Philadelphia, Pennsylvania

Results

Seven teachers completed evaluation forms. Six (86 percent) recommended that the peg kit be produced by APH. The seventh teacher made suggestions for improvement for the production model. All respondents (100 percent) indicated that other available aids did not meet the same needs as the peg set. Positive responses were given to the following features: color, size, texture, ease of manipulation, durability, and type of material used. Four respondents (57 percent) had questions relating to the durability. Suggestions for improvement included:

1. The frames need to be made of a sturdier material which does not freely bend.
2. The box needs to be more durable.
3. The box would be improved if painted inside as well as out.
4. A method of holding the frames more securely is needed.

Summary

The positive response in the field trial supported the recommendation that the peg kit be submitted for production at APH with changes as suggested by the review. This kit is pictured and described in a brochure included in Appendix B.

Task 13 Evaluation of the sensory cylinder set

Project Personnel Fay Leach and Kendrick Coy

Purpose

The Sensory Cylinder Set was developed to provide basic readiness experiences in the discrimination of weight, texture, and color. Incorporated in this aid are aspects of the textured blocks whose development was discontinued due to technical problems.

Procedure

Several models of the sensory cylinder set were developed and reviewed by an in-house APH committee. One model was selected for evaluation to determine whether students could discriminate the weights and textures used.

Testing consisted of three phases: pilot testing, all variables test, and a follow-up test of weight variables.

1) All variables test

Each subject was presented with a total of eighteen paired comparisons. The subject was asked to indicate if each comparison was of the same variable (yes or no answer). There were six comparisons in three categories. Categories included: hard texture, soft texture, and weight. Order of presentation of the categories and comparisons within each category was randomized so that each student received a different presentation order.

To insure that the Ss understood the instructions and meaning of the word "same", four practice trials were given at the beginning of the sessions. Subjects were eliminated from the study if they missed more than one practice trial. The purposes of the all variables test were to determine at what age students can discriminate differences in weight and textures as presented in the cylinder set and to make a short term evaluation of the durability of the cylinders.

2) Follow-up test of weight variables

On Day 1, each subject was presented with five successive trials of the six paired weight comparisons afforded in the sensory cylinder set. The subject was asked to indicate if each comparison is the same. Order of presentation of each comparison was randomized so that each student and each trial had a different presentation order. After each comparison was presented and the subject responded, he was told whether or not his response was correct.

On Day 2, subjects were presented with the 200-300 comparison and asked to identify the heaviest cylinder. The subject was told whether his response was correct or not. Cylinders and position of presentation were randomized.

On both days, a screen was used to prevent the use of vision in the test situation. The purposes of the follow-up test were to determine if successive trials of the six variables of weights when presented with feedback as to the student's performance immediately after each presentation will result in increased discrimination accuracy and to determine if subjects can discriminate differences between the 200 and 300 gram comparison.

Materials

The Sensory Cylinder Set is composed of six fibre cylinders (2 1/2" in diameter, 3" high). These cylinders have been weighted so as to produce three pairs of weights (300, 200, and 100 grams). Plastic styrene and fabrics have been placed in the recessed tops (or bottoms) of the cylinders, affording six textured matches. Secondary colors of purple, orange, and green have been used in the fabric textures; the plastic styrene textures are white. The cylinder set has been so designed that no two matches would be made simultaneously.

Subjects

1) All variables test

The subjects were 65 legally blind students enrolled in the Governor Morehead School, Western Pennsylvania School for Blind Children and Logan Elementary School (Philadelphia, Pennsylvania). Subjects had an age range of 5 years, 1 month to 8 years, 5 months and were divided into the following categories.

	Age Range (yrs., mos.)	N	Mean
I.	5, 1 - 5, 10	9	5, 6
II.	6, 0 - 6, 11	22	6, 6
III.	7, 0 - 7, 11	29	7, 6
IV.	8, 0 - 8, 5	5	8, 2

Nine students were eliminated from the test of the eighteen paired comparisons when they failed to perform on the practice trials. The mean age for these students was 6 years, 8 months. Eight were in beginner-kindergarten groups and one was in first grade. Three were potential braille readers and six were being instructed in print skills. Pilot testing of the cylinders was done at the Kentucky School for the Blind with sixteen primary students with ages ranging from 75 - 108 months.

2) Follow-up test of weight variables

Ten students enrolled at the Southern Baptist Theological Seminary Day Care Center. Subjects were limited to students who have reached their fifth birthday but have not reached their sixth birthday. On the second day of testing, one subject would not participate.

Results

1) All variables test

Percentages of correct responses for the eighteen comparisons are presented in Table 1. There was a progressive increase in the total correct response scores for each of the four age categories with the 8 year old subjects making 90 percent correct responses to 75 percent for the five year olds.

Subjects scored 95 percent correct responses on hard-texture comparisons, 84 on soft texture, and 81 on weight. All except three comparison scores for the 65 subjects were above 80 percent. The three comparisons which were below 80 percent were: 200-300 grams (62%), cotton-satin (69%), and 200-200 (71%). The eleven subjects in the pilot test whose ages ranged from 7 years, 5 months to 9 years, 0 months made no errors on these three comparisons. Rank order of difficulty of comparisons within categories as shown by percentages of correct responses is shown in Table 2.

Percentages of correct responses increased with a parallel increase in the number of years in an educational program (see Table 3). The range of differences in scores between groups based on number of years in an educational program was not as great as the range between age groups. When subjects were grouped according to the number of years in an educational program, the average for all groups was more than 80 percent correct responses on total test performance. On total performance, there was only a difference of six points between first year and third year subjects.

The cylinders proved to be durable during the testing situation. Students attempted to open cylinders but could not. Cylinders were dropped or thrown without apparent damage. Texture discs remained attached and did not show signs of wear.

TABLE 1

Percentages of Correct Responses
on Cylinder Test

VARIABLES		AGE GROUPING*				
		I	II	III	IV	Total
	(N)	(9)	(22)	(29)	(5)	(65)
HARD TEXTURE	Rough-Rough	.889	1.00	1.00	1.00	.985
	Medium-Medium	.889	.955	1.00	1.00	.969
	Smooth-Smooth	.889	.867	1.00	1.00	.938
	Medium-Rough	.778	.818	.931	.80	.862
	Rough-Smooth	.889	1.00	1.00	1.00	.985
	Smooth-Medium	.889	1.00	.931	1.00	.954
	Total	.870	.939	.977	.967	.949
SOFT TEXTURE	Velvet-Velvet	.778	.909	.862	1.00	.877
	Satin-Satin	.667	.867	.897	.80	.846
	Cotton-Cotton	.889	.867	.897	1.00	.892
	Satin-Velvet	.667	.909	.897	1.00	.877
	Velvet-Cotton	.444	.867	.897	1.00	.831
	Cotton-Satin	.667	.818	.586	.80	.692
	Total	.685	.871	.839	.933	.836
WEIGHT (grams)	300-300	.667	.867	.897	.80	.846
	200-200	.667	.773	.655	.80	.708
	100-100	.889	.955	.828	1.00	.892
	200-300	.333	.591	.724	.60	.615
	300-100	.889	.955	.966	.80	.938
	100-200	.778	.773	.931	.80	.846
	Total	.704	.818	.833	.80	.808
Total for all variables		.753	.876	.883	.90	.864

* I - 5 yrs., 1 month - 5 yrs., 10 mos. (Ave. 5, 6)
II - 6 yrs., 0 months - 6 yrs., 11 mos. (Ave. 6, 6)
III - 7 yrs., 0 months - 7 yrs., 11 mos. (Ave. 7, 6)
IV - 8 yrs., 0 months - 8 yrs., 5 mos. (Ave. 8, 2)

TABLE 2

Variable Comparisons: Rank Order of Difficulty

VARIABLE	RANK*
1. Hard Texture	
Rough-Rough	1.5
Rough-Smooth	1.5
Medium-Medium	3
Smooth-Medium	4
Smooth-Smooth	5
Medium-Rough	6
2. Soft Texture	
Cotton-Cotton	1
Velvet-Velvet	2.5
Satin-Velvet	2.5
Satin-Satin	4
Velvet-Cotton	5
Cotton-Satin	6
3. Weight (grams)	
300-100	1
100-100	2
300-300	3.5
100-200	3.5
200-200	5
200-300	6

* least difficult (1) to most difficult (6)

TABLE 3

Percentage of Correct Responses
on Cylinder Test

VARIABLES		Number of Years in an Educational Program			
		I	II	III	TOTAL
	(N)	(30)	(28)	(7)	(65)
HARD TEXTURE	Rough-Rough	.967	1.00	1.00	.985
	Medium-Medium	.967	.964	1.00	.969
	Smooth-Smooth	.90	.964	1.00	.938
	Medium-Rough	.80	.929	.857	.862
	Rough-Smooth	.967	1.00	1.00	.985
	Smooth-Medium	.967	.929	1.00	.954
	Total	.928	.964	.976	.949
SOFT TEXTURE	Velvet-Velvet	.867	.893	.857	.877
	Satin-Satin	.767	.893	1.00	.846
	Cotton-Cotton	.867	.893	1.00	.892
	Satin-Velvet	.867	.857	1.00	.877
	Velvet-Cotton	.70	.929	1.00	.831
	Cotton-Satin	.733	.714	.429	.692
	Total	.80	.863	.881	.836
WEIGHT (Grams)	300-300	.80	.893	.857	.846
	200-200	.70	.714	.714	.708
	100-100	.90	.893	.857	.892
	200-300	.533	.679	.714	.615
	300-100	.933	.964	.857	.938
	100-200	.80	.857	1.00	.846
	Total	.778	.833	.833	.808
Totals for all categories		.835	.887	.897	.864

2) Follow-up test of weight variables

Percentage of correct response on the five successive trials of the paired weight comparisons is presented in Table 4. On six variables there was an average increase by the ten studetts from 78.3 percent correct response on trial 1 to 93.3 percent on trial 5. The 200-200 grams and 200-300 grams comparison presented the most difficulty.

TABLE 4

SUCCESSIVE TRIAL TEST OF SENSORY CYLINDERS - WEIGHT VARIABLES
PERCENTAGE OF CORRECT RESPONSES

Variable	Trial 1	2	3	4	5	Average
300-300	90	90	100	100	100	96
200-200	50	80	90	60	70	70
100-100	90	100	100	100	100	98
200-300	70	60	80	60	90	72
300-100	90	90	90	100	100	94
100-200	80	70	100	100	100	90
Total	78.3	81.7	93.3	86.7	93.3	86.7

On Day 2, comparisons of the 200-300 gram variable, nine students participated. All nine students were able to identify the heavier cylinder five times without error. In 45 total presentations there were no errors made in identifying the 300 gram cylinder as being the heaviest in comparison to a 200 gram cylinder.

Summary

On the basis of the evaluation, it was recommended that the sensory cylinders be submitted for production by APH. These materials are currently in production and are pictured and described in a brochure in Appendix B.

CHAPTER NINE

ADAPTATION OF MATERIAL FOR THE MULTIHANDICAPPED VISUALLY IMPAIRED

Work in this area was initiated with a general survey of materials needs of multihandicapped children. The finding that the greatest problems lay in the communications area pinpointed IMRC development activity in this area. All efforts in providing communications materials have focussed in identifying and, where necessary, adapting materials already available from commercial developers and producers. A program for teaching general listening skills has been adapted. The possibility of developing a special teacher's manual in the area was explored. In conjunction with this, available recorded language materials were catalogued and a listing of these published. An inexpensive model of a player for audio cards was evaluated and ways to provide audio cards usable on a variety of card players were explored. Finally, efforts were begun to develop a comprehensive set of materials to teach auditory and oral language to very young multihandicapped children. These efforts are still under way and progress achieved during the IMRC grant period is described largely through reports of meetings of the advisory committee for this activity.

Task 1 Multihandicapped visually impaired children: instructional materials needs survey

Project Personnel Fay Leach

Purpose

The multiply handicapped visually impaired (MHVI) child has become a focal point of increased interest and concern. The rapidly expanding birth rate, high incidence of disability with a much higher survival rate among premature infants, and rubella epidemics have all contributed to the growing numbers of such children. Consequently, there have been increases in the number and variety of services for children who have one or more major handicaps in addition to visual impairment. This in turn has led to a growing demand for the development or identification of materials that are suitable to the education or habilitation of these children. Little information describing needs exists in current literature.

As a first step in a program directed toward meeting these demands, a survey of programs for the MHVI child was undertaken by the APH IMRC. The purpose of this study was to survey the needs of the MHVI child in order to formulate implications for the development of instructional materials. The MHVI child was defined as a child who has two or more educationally significant handicapping conditions, one of which is visual impairment.

Procedure

This survey was divided into three phases. The first was a background study of the literature on the MHVI child. The second and major source of data was a questionnaire sent to educational organizations serving MHVI children. Finally, information was obtained through interviews conducted with administrative and teaching personnel from a number of selected programs.

Subjects

Replies to the two-part questionnaire were received from 258 of 293 organizations which had been identified as possibly having educational programs for MHVI children. Ninety-nine of these failed to meet the criteria for the study; consequently, results were based on data describing 3,443 MHVI children in 159 organizations. These organizations had a variety of types of programs for MHVI children and provided a widespread geographical representation.

Results

Literature review

The literature on the MHVI child makes only a few specific references to instructional materials. These references most often refer to materials which might be used with younger children. A number of organizations were able to use regular educational nursery materials. Some organizations indicated that they designed their own materials. Readiness materials and materials for the development of basic skills were also utilized.

A need for more records and tapes was expressed. It was stated that it has been difficult to find high-interest low-vocabulary materials.

Questionnaire Survey

The MHVI child was generally depicted as a child with complex needs. A summary of the MHVI children reported indicates that:

1. Seventy-six percent were classified as requiring individualized instruction most of the time.

2. Nearly one-half were 13 or older.

3. Twenty-four percent were considered non-verbal.

4. The mode of learning used was reported as follows: (a) braille, 28 percent; (b) large type, 29 percent; (c) regular type, 4 percent; (d) listening materials only, 27 percent; and (e) none of the above, 12 percent.

5. Visual acuity was reported as follows: (a) totally blind, 37 percent; (b) visual acuity of 20/200 or less, 43 percent; (c) visual acuity between 20/200 and 20/20, 11 percent; (d) severe peripheral loss, 6 percent; and (e) degree of vision unknown, 9 percent.

6. Only 45 percent were classified as being in an academic subjects oriented curriculum.

7. Sixty-one percent were in programs with 50 or fewer MHVI children.

8. An average of 3.28 handicaps per child was indicated. Visual impairment, mental retardation, speech defects, and emotional disturbance were the handicapping conditions of most frequent occurrence.

9. The four problems which most hindered learning were: (a) nonattending behavior, (b) emotional disturbance, (c) experiential deprivation, and (d) communication and language problems.

The educator must have a variety of materials which utilize different learning modes. He must also attempt a number of approaches and methods. A great deal of creativity is required to communicate with a child who uses neither braille, print, nor listening modes. A child who shows nonassertive or withdrawal behavior and who requires individualized instruction may be particularly difficult to motivate. Instructional materials need to be designed to encourage independent functioning as much as possible in order to free the teacher to work with other students. Many materials will not interest the child and therefore the selection of materials is especially important. Listening materials apparently can be used with the largest number of MHVI children, and more students use print than braille.

Because there are small number of MHVI children located in any one locality materials should be as multipurpose as possible. This is also true in the light of the diversity of needs and types of handicapping conditions. For example, one special need is the adaptation of materials for the older child who is functioning on a very elementary level.

Respondents indicated communication skills to be the area of most significant educational concern for MHVI children. A closely ranked second was the development of self-care and daily living skills. Of third priority was orientation and mobility skills.

Respondents were asked to indicate the percentage of instructional time spent in various areas. This information was analyzed in two ways. First, a rank number of 1 to 8 was assigned to each area with 1 indicating the area of most time spent and 8 the least. Second, an average of the percentage of time was obtained for each area. Some answers could not be used for this second measure because a base of greater than 100 percent had been used by respondents. The rank order of the instructional areas was as follows: communication skills (1), cognitive processes (2), sensory development (3), motor skills (4), self-care and daily living skills (5), self concept formations (6), mobility and premobility skills (7), and other (8).

There was a difference in rank ordering using the two methods of analysis of this data. Motor skills, self-care and daily living skills, and sensory development took a slightly different rank position. There was a difference of less than 1 percent of the mean scores of these three areas. The Spearman rank correlation coefficient was applied to measure the association between the two samples. There was a relationship (r = .93) between the two forms.

Respondents emphasized curriculum as the main difference in educational programming for a MHVI child and a child with visual impairment as the only handicap. It was held that the curriculum for the MHVI child should be more experience and life centered and that it should stress concreteness. Secondly, responses pointed out the need for more work with MHVI children in language and communication development.

Greater use of repetition was held to be especially essential in the learning process. Another often repeated need was that of instructional materials especially designed for MHVI children.

Teachers frequently attested to having an inadequate knowledge of available materials and the best selection procedures. They felt there was a need for development of materials in all areas but that these must be especially for the MHVI child. Another reply often repeated was that there were few suitable materials available.

Suggestions of the most beneficial materials for each of the instructional areas were made. Respondents proposed a number of general suggestions concerning materials needs. They stated that there should be more materials which:

1. Relate to practical and real situations.
2. Are of high interest low vocabulary nature.
3. Are for mentally retarded blind children.
4. Focus on concreteness, physical attractiveness, and flexibility.
5. Use color (especially in large type materials).
6. Meet the needs of the older child with low functioning.
7. Are especially sturdy and durable.
8. Emphasize prevocational and vocational skills.
9. Creatively present basic concepts in a variety of ways.
10. Can be used as games for older children.
11. Can be used by parents.
12. Utilize listening skills at the levels of low-functioning children.
13. Are multisensory and multipurpose.
14. Stress sequential learning.
15. Feature communication skills development as a primary focus.

Suggestions of instructional materials which need to be developed were made by 180 respondents. The largest number of suggestions was in the areas of motor and communication skills.

Visits to Organizations Serving MHVI Children

In the visits to organizations serving MHVI children, the following was obtained: first-hand information as to the educational program for mhvi children, information on materials needs, evaluation of types of materials which had proved useful to mhvi children, and suggestions for materials which should be developed or adapted.

The following organizations were visited in gathering first-hand information:

Callier Hearing and Speech Center, Dallas, Texas
Dr. Ed Hammer, Coordinator for the Louisiana, Texas, and Oklahoma Center for Services to Deaf-Blind Children
Joaquin Miller High School, Los Angeles, California
Sven Lokrantz Elementary School, Los Angeles, California

Meeting of the Los Angeles County Association of Special Educators,
Teachers of the Visually Handicapped
Instructional Materials Center, Los Angeles, California
Department of Special Education, Los Angeles Unified School District,
Mr. Ralph Salaway, Supervisor of Blind and Partially Seeing
Miss Joan Sweeney, Consultant in Education of the Visually Handicapped
for Southern California
Foundation for the Junior Blind, Los Angeles, California
Blind Children's Center, Los Angeles, California
Oregon State School for the Blind
California State School for the Blind
Mr. Paul Starkovich, Northwest Area Coordinator for Services to Deaf-
Blind Children
Washington State School for the Blind
Illinois Braille and Sight-Saving School Unit and Special Classes for
mhvi children

The organizations visited revealed that moves have been made toward serving lower functioning children and children with more complicated problems. This was true even in the public school programs. There were also efforts being made to reach mhvi at young ages. Some of these children were babies in their first two years of life.

Two of the residential programs visited were geared almost completely to serving children who could not fit into local day programs; most of these children were multiply handicapped. However, personnel at one school indicated that they were shortening their evaluation period and were beginning to send some of their children with very limited functioning back to their homes.

There appeared to be a very clear division in the organizational structure of the educational provisions for visually impaired children who have other handicaps. One provision is made on the basis of an adapted academic program; the other emphasizes training in practical living and socialization skills.

Well over seventy-five percent of the young mhvi children seen, especially deaf-blind children, were possible large type users. The curriculum did not appear to be largely textbook oriented. It was geared more to actual life situations than to a formal academic structure.

Teachers who appeared to be doing the best work with their students had spent a great deal of time making their own materials. Most of the teachers were eager to discuss their work. They stated they often found problems with the usefulness of materials purchased and were left with items which they could not use. This was due to the fact that too much was required of the child at one time and the wide range of needs presented by these children.

Many of the teachers contacted expressed a need for assistance in knowing available resources of materials and how to select these. Instructions as to ways the materials can be used should accompany instructional materials.

Summary

Communication skills, self concept formation, sensory development, and motor skills were the four areas in which respondents ranked the need for instructional materials as being greatest. Motor skills, communication skills, and sensory development were the areas in which were given the most suggestions of materials which had been beneficial. It was in these same three areas where persons were able to make the most suggestions of specific materials needing to be developed. Self-concept formation ranked last in the number of suggested materials that have been beneficial.

The types of materials suggested as beneficial were very similar to materials used by very young children. The types of materials most frequently suggested were those which are designed to teach basic skills at an elementary level.

Teachers frequently attested to a feeling of inadequacy of knowledge of the availability and best selection of materials. This may be both a cause and a result of the fact that literature on mhvi children deals very little with instructional materials. There were repeated requests for assistance in this area as well as suggestions that a means of an interchange of information should be promoted. Several respondents suggested that institutes on instructional materials are highly desirable.

Ideally, the facilities for a program for mhvi children should include a variety of provisions geared especially for the development of physical abilities and practical living skills. The suggestions of facilities for a program for mhvi children should include a variety of provisions geared especially for the development of physical abilities and practical living skills. The suggestions of facilities were very ordinary. There appeared to be less focus on formal, rather than on informal, academic classroom arrangement.

The mhvi children in this study need materials which are multipurposive and multisensory. Respondents in the study proposed that these materials need to be especially attractive, durable, and practical. Practicality was indicated as a key feature for which to look. It was stated that materials need to emphasize basic skills development and simplicity. Communication skills development was suggested as the area of most critical need.

Task 2 Adaptation of the Listen and Think taped lesson program

Project Personnel Fay Leach

Purpose

A survey of the educational needs of multihandicapped students supported the need to adapt materials designed for the development of listening skills and which could be used by students whose input was largely aural. Educational Developmental Laboratories granted APH special permission to adapt the "Listen and Think" taped lesson program for use with visually handicapped students. Surveys of available materials showed that these materials ranked high in quality and in adaptability.

Procedure

The adaptation required an initial phase in format development and pilot testing. Once an appropriate format was developed the adaptations of additional levels were completed. Finally additional levels were field tested by teachers using these with their own students.

Evaluation procedures included:

1. An Observer Rating Checklist for each lesson and group to whom the lesson was given. An observer was to complete a checklist indicating observable responses on all essential features of the format and basic materials. Difficulties, student reactions, and special comments were to be included.

2. A Student Questionnaire. This was administered orally at the completion of all lessons presented. Students were asked prepared questions which allowed them to indicate the degree of helpfulness of basic features and specify any difficulties. The students were also questioned concerning their opinions of the program.

3. A Teacher Evaluation Sheet. This was completed by the regular classroom teacher. This called for evaluation of the program and the student performances. Suggestions for changes in the materials were requested. The teacher was asked to rate various features in the program.

4. Analysis of comprehension scores for each lesson. Both skill and comprehension questions were given orally on the tape. Students used an answer sheet to indicate their responses. Percentages of correct responses were computed and used in the following manner. (a) Analysis of errors by question--The percentage of correct response was computed for each question in each lesson. The purpose of this analysis was to pinpoint questions which were too hard, too easy, or ambiguous, and therefore, needed to be rewritten. Any question with an average percentage

of correct response lower than 60% was analyzed. (b) Analysis of percentage of correct response by lesson - The average scores of students functioning on appropriate grade levels was computed. Criterion of acceptability of each lesson was an average score of 70% or better. Any lesson not meeting this criterion was analyzed in comparison with the question error scores in order to determine procedures for revision.

Materials

EDL designed the program for the purpose of improving listening comprehension and developing specific thinking skills that are necessary to good listening. It is presented in such a way as to call upon the student to use analytical, interpretive, appreciative, and critical skills in a carefully planned progression. Lesson activities give the student practice in such skills as: Listening, Identifying Main Ideas, Recognizing Sequence, Summarizing, Classifying, Outlining, Comparing, Recognizing Cause and Effect, Predicting Outcomes, Using Our Senses, Visualizing, Understanding Character, Understanding Setting, Sharing Feelings, Enjoying Humor, Recognizing Climax, Recognizing Foreshadowing, Recognizing Purpose, and Distinguishing Between Fact and Opinion.

Materials provided in the adapted program include:

15	Revised Taped Lessons (reel or cassette, 20-30 minutes each)
250	Braille Answer Sheets
250	Large Type Answer Sheets
36	Plasti-crayons (18 read and 18 blue)
1	Tape: "How to Use Your Answer Sheet"
50	Braille Progress Charts
50	Large Type Progress Charts
300	Marking Pins
1	Teacher's Handbook
1	Suggestions for Use of the Adapted Program

The taped lessons, requiring from 30 to 40 minutes, should be depicted as only one part of the total program. The Teacher's Handbook, an especially valuable tool, gives synopses of the lessons and suggestions for coordinated activities which could be used before or after the taped lesson.

Speeded listening is used in the Listen and Think series. This technique is made possible by means of special recording equipment which quickens speech electronically without making it distorted. The stories presented with the use of the speeded listening technique are at a rate slightly faster than the reading rate for the grade level.

The Revised Taped Lessons have an integrated question-activity section and employ a response method which can be readily used by the visually handicapped student. Separate answer sheets for each student are required. One of the most significant features is that students can use the taped lessons independently (whether on open-reel or cassette tapes). Only a minimum of Braille or large type skills is required therefore, students who are not proficient in reading and writing Braille or ink print may also participate.

The Answer Sheets (Braille or large type) provide a simple method of responding to auditory questions. Each sheet is numbered 1-20, with answer choices labeled a, b, c, d, and e. For either the Braille or large-type answer sheet, a plastic crayon is provided. In the case of the Braille user, the marker can be used to erase the Braille letter, which helps the student to check his own answers. The large-type user simply marks the letter which represents the correct answer.

The Progress Charts (Braille or large-type) provide a means whereby students can study their progress on a series of lessons or tests. Each sheet is numbered 1-15, consecutively, on the horizontal axis, with 25 to 100 percentile scores (by units of 5) on the vertical axis.

Braille charts are embossed with horizontal and vertical lines of Braille dots on white 11 1/2" x 11" Braille paper. Vertical line-spacing is 5/8" and horizontal spacing is 1/2".

Large type charts are printed with bold black lines at a 1/2" vertical and horizontal spacing, on white 8 1/2" x 11" paper.

These charts may be mounted on bulletin boards or currugated cardboard. Scores may be plotted by the student or teacher with commercially available map-marking pins or small tacks. Young students will be able to read the scores plotted by the teacher, but more advanced students can both plot and read their own scores. This can be good introduction to work with graphing.

Subjects

Phase I - format development and pilot testing:

Seventy-seven students in grades 4-6 and upper elementary non-graded students at the Governor Morehead School, Raleigh, North Carolina and 31 students, grades 4-5, at the Missouri School for the Blind, St. Louis, Missouri. Six elementary students and six 8th grade students at the Kentucky School for the Blind participated in the development of the answer sheet format. All fourth grade students at the Kentucky School for the Blind, Louisville, Kentucky, participated in the pilot testing.

Phase II - adaptation evaluation:

Fourteen students from grade 2-5 at the Kentucky School for the Blind, Louisville, Kentucky, three students in grades 5-6 at the Cochran Elementary School, Louisville, Kentucky, and four students in grades 5-6 at the Semple Elementary School, Louisville, Kentucky.

Phase III - evaluation through teacher use:

Thirty-one students in grades 7-10 at the Arkansas School for the Blind, Little Rock, Arkansas, 22 students in grades 8-12 at the Washington State School for the Blind, Vancouver, Washington, and 15 students in grades 4-6 at the Kentucky School for the Blind, Louisville, Kentucky.

Results

Phase I - format development and initial pilot testing:

Level C was selected for the development of the basic format. Fourth grade students at the Kentucky School for the Blind participated in the development of the edited taped lessons. Initially the taped lesson was stopped at the appropriate time and the workbook section was read to the students. An improvement was made by having the question and answer recorded and spliced into the tape at the appropriate places. This gave the teacher more freedom to attend to other aspects of teaching. The greatest difficulty in the use of the lessons came in the method of response to the questions. Use of Braille writers interferred with hearing the tape. Students had difficulty in brailling and writing their answers.

Braille and large type answer sheets were developed for use with the taped lessons. These sheets were submitted to an APH educational review meeting. Two suggestions came from this review: (1) That two formats for the answer sheet be developed and tested and (2) that a preparation lesson be developed for the purpose of helping students in learning to use the answer sheets. A preparation lesson and two formats of answer sheets were developed and tested with students at the Kentucky School for the Blind. Revisions were made.

Five taped lessons from Level C and a preparation lesson were developed for field testing with grades 4-6 and upper elementary non-graded students at the Governor Morehead School, Raleigh, North Carolina. Students were able to adequately use the lessons and materials. The average score on comprehension questions was 79.5 percent and on skill questions was 76.2 percent. Minor revisions were made in the program on the basis of this field test.

Students at the Missouri School for the Blind participated in the testing of a revised format. Average scores ranged from 73.1 to 82.1 percent correct responses. On the basis of the test, the taped preparation lesson was recommended for production. Two other changes were suggested for the production model of the lesson format.

A manual of suggestions for use of the adapted lessons was written. This manual was designed to augment the teacher's handbook and to give specific guidelines for using the materials with visually impaired students.

Phase II - adaptation evaluation:

Level B and F were adapted to fit the format which had been developed. All fifteen lessons were tested with students. Average scores on Level B ranged from 79.5 to 96.1. Errors were analyzed and necessary changes were made.

Average scores on Level F ranged from 52 to 85 percent. An analysis of errors revealed that students were having difficulty with questions having more than one answer. A new preparation lesson on "how to use your answer sheet" was written to give additional practice in responding to this type of question. After an error analysis, corrections were made in Level F lessons.

Phase III - evaluation through teacher use:

Eight teachers assisted in the evaluation of Levels E and G by using these with their students. Average scores on both levels were above the 70 percent criterion. Minor revisions were made based on teacher suggestions and error analysis. A new preparation lesson was written for students functioning on or above the 8th grade level.

Levels H and I are to be adapted and tested through teacher use during the 1974-75 project year.

Summary

Six levels of the "Listen and Think" program have been adapted, tested, and submitted for production with two additional levels currently being adapted. At the end of September, 1974, more than 500 units had been ordered. At the end of September, 1974, 9,377 packages of answer sheets had been ordered. Completion of the entire program is scheduled for August, 1975. Production materials are pictured and described in a brochure included in Appendix B.

Task 3 Survey of available recorded language materials

Project Personnel Fay Leach

Purpose

The purpose of this survey was to develop a listing of available recorded materials in the language skills area.

Procedure

A survey was made of catalogues of commercial distributors of recorded materials for instruction in language skills. Available materials were listed and classified under one of the following categories: communication programs, listening skills, phonics, speech, language concepts, spelling, and teacher training. Included also was the source of each materials and its price.

Results

A 48-page listing was developed and printed. This was distributed by the Instructional Materials Reference Center. A second printing was done in 1972.

Task 4 To evaluate the Instructasette System

Project Personnel Fay Leach

Purpose

The Instructasette System, Biodynamics, Inc., is a cassette player which has been modified to play and record audio cards without greatly increasing the equipment cost. The purpose of this task was to explore the usefulness of this system with visually impaired students with the possible consideration of the future development of tactual software for the system.

Procedure

Sample cards were developed and used with four students, ages 6 and 7. Reports on the observations of three teachers were obtained. Similar machines were evaluated in comparison to the Instructasette System.

Results

It was necessary to develop a special card feeder for use with this machine. Students functioned well in the pilot test of the machine with the feeder. The examination of the machine revealed limitations in the uses and durability of this system. Due to changes in the organization of this company, a cooperative endeavor in the development of audio-card software became no longer feasible. Machines from three other companies were examined and found much superior in quality. The prices of the other available audio card readers are much higher than the Instructasette System. Experimentations revealed the possibility that software could be designed which could be used on all four devices examined.

Task 5 Feasibility study on the development of tactual-auditory cards

Project Personnel Fay Leach

Purpose

Experimentation with the Instructasette System, Biodynamics, Inc., revealed the possibility of developing software which could be used on all of the major audio card reading equipment. The purpose of this feasibility study was to develop and pilot test prototypes of audio cards which could be used by visually impaired students.

Procedure

Two sets of initial prototypes of audio-cards were developed for experimental purposes. Cards with raised figures made of Braillon were created through thermoforming. Five companies were consulted concerning technical aspects.

Results

Present production methods are not readily convertible for production of a thermoformed card which can be produced on a quantity basis. The major problem encountered was that the adhering of the audio tape required precision techniques for quality audio production. This would require the development of special machines. The technical production cost projections made the continuation of this project inadvisable. If the technical problems are resolved, a study of content priorities for the audio-tactual cards was recommended.

Task 6 Questionnaire Survey: Educational materials and early audiolinguistic skills development of the visually handicapped child

Project Personnel Fay Leach

Purpose

The purpose of this survey was to gain information on the early auditory and oral language skills development of visually handicapped children. This information was used to guide design in the early auditory and oral language skills project.

Procedure

Seventeen persons were identified by trustees and administrators at the annual APH meeting, October 1972 as persons involved in an active program of early audiolinguistics skill development for visually handicapped students. Twelve of the seventeen persons (71%) responded to a questionnaire. A compilation of the responses to each question was made and submitted to the audiolinguistic skills development project committee for review and use during the workshop, January 24-26, 1973. The committee provided a system for classifying specific audiolinguistic problems identified in the questionnaire responses.

Results

The following is a listing of the responses to the questions. The number of times this response was given is indicated immediately following the response.

I. Specific problems in early audiolinguistic skills development observed in visually handicapped children

1. Awareness-attention
   a. short attention span (2)
   b. poor motivation, lack of curiosity
   c. poor listening skills

2. Auditory perception (auditory memory, auditory discrimination, figure-ground)
   a. poor recognition of environmental sounds
   b. inability to carry out more than a two-part command (1)
   c. poor auditory memory
   d. trouble with rhyming words (1)
   e. problems in associating sound with its source
   f. frequently cannot identify sounds other than words, cannot localize sources of sounds, cannot identify sounds with words
   g. poor listening skills
   h. lack of auditory discrimination

3. Conceptual-association
    a. inability to get the main idea or facts from a story
    b. lack of concepts involving time, space, body image, and directionality
    c. unawareness of parts of objects
    d. difficulty in going from a general category to specifics
    e. inability to understand figurative speech

4. Grammatical (lexical, morphological, syntactical)
    a. confusion of sentence order
    b. difficulty with verb tense
    c. limited vocabulary
    d. inability to understand figurative speech
    e. trouble with homographs
    f. slow in naming or labeling things
    g. learning of location words, which effects syntactic acquisition of prepositions
    h. articulated nouns only
    i. lack of or misuse of pronouns, especially those dealing with self concept (1)
    j. use of words or phrases rather than sentences
    k. late speech development

5. Speech (articulation capacities)

    a. articulation problems such as distortion or sound substitutions-substitutions of bilabial sounds, confusion of sounds which are aurally similar, or dependent on visual cues
    b. very fast speech, barely audible
    c. poor articulation

6. Personal-social relationships
    a. inappropriate behavior for interpersonal situations
    b. poor motivation, lack of curiosity
    c. lack of socialization
    d. lack of motivation which seems related to experiential deprivation
    e. distracting self-stimulating behavior on part of the children
    f. fear of new situations

7. Expressive (vocal, motor)
    a. no speech at all (3)
    b. babbling
    c. echolation (especially repetition of T.V. commercials)
    d. speech with no meaning
    e. lack of verbal relating of experiences
    f. preference of non-verbal communication
    g. preservation of one activity or sound for self-stimulation

Generally, experiential deprivation (3) and not having the experience of having an older child or adult read to the visually handicapped children were given as causes of some of the above problems.

II. Problems in the process of preparing to teach or teaching early audiolinguistic skills to visually handicapped children

1. Lack of prepared sequential materials (2)
2. Lack of listening materials
3. Difficulty in arranging for field trips
4. Difficulty in finding concrete objects to teach vocabulary and helping build concepts
5. Difficulty in obtaining reasonable replicas of objects
6. Too many children
7. Too wide a variety of needs
8. Lack of language tests appropriate for visually handicapped children
9. Lack of research and literature on visually handicapped (2)
10. Difficulty in capturing the child's attention and interest (1)
11. Difficulty in inventing games enough that appear over and over again each day--imitation of sounds heard, localizations of sounds, discrimination of sounds (both spoken word and other sounds that demand an appropriate reaction. . .i.e., the fire bell, a fog horn, a car horn, etc.)
12. Teachers are not convinced of value of listening materials
13. Lack of early identification of problems
14. Lack of resource people or specialists to work directly with children
15. Lack of parent training programs
16. Incomplete medical work-ups
17. Lack of meaningful teaching units
18. Lack of accurage audiological, opthamological, and psychological testing
19. Lack of multi-sensory stimulation equipment
20. Lack of interesting and motivating materials to teach listening skills
21. Parents need a great deal of help in teaching their children
22. Parents often do not follow through with activities for their children
23. Materials are not geared to this type of child
24. Difficulty in evaluating hearing and overall responsiveness
25. Children are autistic

III. Instructional materials or educational aids deficits

1. A sequential guide line for skills to be taught at each level
2. Appropriate listening materials
3. Lack of articulation and language measuring instruments geared specifically to the visually handicapped
4. Need for objects from daily experiences
5. Need for pictures which are large, clear, colored, and lifelike--which depict objects and events meaningful to the children. Cluttering is avoided.
6. Materials which relate tactual cues to auditory cues without mediation of sight
7. A greater variety of records and tapes
8. Lack of high interest materials
9. Paucity of materials for low vision students
10. Lack of a variety of materials to present the same concept
11. List of suggested books for parents to read to their children

12. Most available materials are geared to the sighted child
13. Materials need to possess texture, sound, and a way of manipulating them easily. (1)
14. Need materials which cover different areas of learning in a systematic logical way.
15. Records are not simple enough and are meaningless to these children.
16. Need records with basic sounds repeated over and over again.
17. There needs to be a variety of ways to manipulate sound makers.

IV. Available instructional materials which are considered valuable in teaching audiolinguistic skills to young visually handicapped students

1. Peabody Language Development Kits (5)
2. Barnell-Loft Specific Skill Series A-F
3. Language Lotto
4. DLM Buzzer Board (1)
5. Tok Back (to monitor own speech)
6. Tape recorders and headsets (4)
7. Talking Book machine and library books (2)
8. Opague projector
9. Language Master (1)
10. Hand puppets and puppet stage
11. Marionettes
12. Braille writer
13. Fitzgerald Key
14. Little Plays for Little People by Vogel
15. Talking Time by Scott, Thompson
16. Time for Poetry by Arbuthnot (choral reading and listening to poetry)
17. Better Speech and Better Reading by Schoolfield
18. Hailstone and Halibut Bones by O'Neal (to teach color by tasting, smelling and hearing)
19. Speech Therapy with Children by Backus and Beasley (interperson situations and appropriate speech patterns)
20. Auditory training devices (1)
21. Letters and objects which are rough and can be traced with the finger
22. Small plastic animals
23. Early Childhood Record Series (Kimbo)
24. I Heard It with My Own Two Ears (Miller Brody)
25. See-Through Sound Cylinders (Maplewood)
26. Audi-Ball (Const. Play.)
27. Basic Training in Auditory Perception (Concept. Rec.)
28. Listening with Mr. Bunny Big Ears (Kimbo)
29. Building Verbal Power (Ed. Rec. Sales)
30. American Encyclopedia of Learning Through Music (Miller-Brod.)
31. Meet Mr. Mix-Up
32. Who Said It?
33. Listening Skills Program (SRA)
34. EDL Listen and Think Program
35. Progress in Oral Communication, Alameda County

36. Rhythm instruments
37. Pre-recorded environmental sounds
38. Sense and Tell (Scott, Foresman) Teacher's guide (1)
39. Kirk and Kirk, Psycholinguistic Learning Disabilities: Diagnosis and Remediation
40. Phonic Mirror (2)
41. Xylopipes by Creative Playthings
42. "A Guide for Parents of Deaf/Blind Children" by Peggy Freeman (Univ. of Mich.)
43. Perkins book on education of deaf/blind
44. Hearing Therapy by Streng
45. John Tracy Clinic Correspondence Course
46. Materials from the Mountain Plains Regional Center for Services to DB Children
47. Bereiter and Engelman's book on teaching disadvantaged preschoolers
48. Listening and Learning Houghton Mifflin Co. (record)
49. Early Learning Experiences (pamphlet) Bessie Chandler
50. Auditory Training Tape (DLM)
51. Sounds I can Hear (Record Set from Scott, Foresman)

V. Suggestions for improving educational procedures and materials used in the development of early audiolinguistic skills in visually handicapped students.

1. Development of sequential listening tapes for K-3rd grades
2. A teachers' guide for language development, presenting a sequential program which moves from the general, concrete to abstract thinking.
3. Present language testing instruments need to be adapted for the blind
4. A manageable articulation inventory for blind children
5. Recorded stories emphasizing language skills, using sound effects, perhaps in a kit with meaningful objects.
6. Need small shapes which could be used in developing oral sensation.
7. Materials should be accompanied by simple and direct instructions (1)
8. Materials need to be sequenced.
9. Teachers need training in how to build listening into every lesson they teach
10. Checklists for identification of stage or state of development
11. Better records and assessment programs (1)
12. Indexing system with materials
13. Materials need to be developed which pair the sensory modalities of audition and taction
14. A carefully planned program in auditory training
15. More day programs for pre-schoolers
16. Children need experience books to help build receptive language
17. Parent-home counseling
18. Need earlier identification
19. Need methods of individual programming
20. A bibliography of books to be used with blind children from infancy to 5 years is needed for both teachers and parents.
21. More information is needed to help the teacher.

Task 7 Advisory committee meeting: Early audiolinguistic development and the visually handicapped child, January 24-26, 1973.

Project Leader Fay Leach

Purpose

To facilitate the development of early auditory and oral language skills in visually handicapped students (giving special consideration to the problems of the multi-handicapped) by:

1. Identifying problems and needs in the development of auditory and oral language skills development.
2. Outlining goals for meeting these needs and problems and identifying goal priorities.
3. Identifying instructional materials which need to be adapted or developed.
4. Reporting on materials which are commercially available and have been valuable for children with visual handicaps.

Procedure

A team of five project consultants was asked to serve on the audiolinguistic project advisory committee. These persons were chosen on the basis of knowledge of elementary auditory and oral language skills development and experience in teaching language skills to visually handicapped children. A workshop, January 24-26, 1973, was the first formal meeting of this committee.

In preparation for this meeting, a survey of available education materials and a questionnaire survey on audiolinguistics skills development were made. This information was summarized and sent to the committee prior to the meeting dates. A copy of the project proposal was also sent in advance. The committee was requested to define general and specific guidelines for the project.

For the purpose of this project, early audiolinguistics skills were to be considered as those aural/oral language skills which are developed by age six in normally functioning children.

Participants

Mrs. Cathy Groves, Director, Child Study Center, Oklahoma University Medical School, Oklahoma City, Oklahoma

Mrs. Ann R. Headlee, Speech Pathologist, Murdoch Center, Unit for Blind Multi-handicapped Children, Butner, North Carolina

Mrs. Kathryn B. Horton, Chief, Language Development Programs, Bill Wilkerson Speech and Hearing Center, Nashville, Tennessee

Dr. Merle Karnes, Institute on Exceptional Children, University of Illinois, Champaign, Illinois

Mrs. Kay Loss, Language Program, Arkansas School for the Blind, Little Rock, Arkansas

Mr. Anthony J. Biacchi, Educational Materials Research and Development Assistant, American Printing House for the Blind, Louisville, Kentucky

Dr. Fay Leach, Educational Materials Research and Development Specialist, American Printing House for the Blind, Louisville, Kentucky

Dr. Carson Y. Nolan, Coordinator, Educational Research, Development, and Reference Group, American Printing House for the Blind, Louisville, Kentucky

Results

General suggestions or comments:

1. The focus of the audiolinguistic skills development project should be more on the adaptation of presently available materials than the development of new materials. After surveying what is available and the adaptation of the same, if there are areas of need for which materials are not available, then the development of new materials is appropriate.

2. All materials should be accompanied by appropriate curricular materials. This might include:
   a. A list of skills that might have been worked on before this activity.
   b. Skills necessary to the activity.
   c. The sequential steps of the activity.
   d. A suggestion of how the teacher might expand the activity, e.g. other activities working on the same sort of idea or goal as the material at hand.
   e. Activities that might follow the mastery of the activity at hand.

3. The focus on early intervention is especially critical in the development of audiolinguistic skills of visually handicapped children. By focusing on the early years with the visually handicapped child we have the following opportunities:
   a. To ameliorate some of the language problems we see at an older age.
   b. To approach them at the time that attention to audiolinguistic skills are crucial to the child's total development.

4. Training of teachers, parents, cottage, or houseparents is of first priority in meeting the problems of audiolinguistic skills development of visually handicapped children.

5. There is a major deficit in curricular materials for the teacher to use with visually handicapped children. This deficit must be met before the best strategy of materials development can be proposed.

6. A structured bisensory or multisensory approach is especially significant in the language development of visually handicapped children.

7. There should be provision of a method of continual survey of available materials which should be incorporated in the audiolinguistic skills project.

8. Materials for visually handicapped children should relate tactual, kinesthetic, and stereognostic cues to auditory cues.

9. Materials for visually handicapped children need to provide methods in which the child has opportunity to manipulate or operate on his environment. There needs to be a cause and effect hook-up in the material. The child needs to begin to get the sensorimotor experience that his behavior has an effect; that he has the capacity to get something done.

10. There must be significant differences in structuring and interpreting the environment for the visually handicapped child in order to provide for the maximum development of audiolinguistic skills.

11. There are increasing numbers of children with a variety of degrees of language disabilities and auditory perceptual problems.

12. While training materials and activities may be primarily geared for teachers, they should be conducive to that which can be used by parents at home and cottage parents in the residential setting.

13. The visually impaired child's ability to generalize from a particular language label or concept and make sound associations is more limited than the sighted child's.

Suggestions for educational materials development and information services

The first priorities were:

1. To conduct a survey of the major pre-school language development programs, evaluating their adaptability for use by visually handicapped children and their capacity for meeting specific problems of audiolinguistic functioning. Adapt selected curricular materials on language development with the consideration of providing supplementary materials on the basis of deficits.
    a. Investigate development of supplementary and/or substitute materials to accompany the PLDK-P with guidelines for use.
    b. Review other major curricular materials programs with the same objective in mind.

2. Adapt or develop a slide series (consider video tape media also) with accompanying printed materials on rules for talking to visually handicapped children. This would be for both parents and teachers. The series

would emphasize touch and be especially relevant for non-visioned children.

3. An annotation of listing of all available materials on auditory training with the view of the need to develop additional materials and guidelines. The focus on the development of materials is on those which would facilitate maximal auditory and listening skills with special attention to the meaning of language.

4. To edit and adapt the Barnell-Loft Specific Skills Series for recorded media.

5. An annotated listing of films and other audio visual media that have special relevance to the Visually Handicapped Child regarding language and speech development and behavior management. This would be geared primarily for teachers but would also be useful for parents.

The second priorities were:

1. To provide a better quality of recorded materials for use in grade 3 and under. (Many of currently available talking books are inappropriate for young visually handicapped children.) Talking books of this level need to be made available to parents.

2. An annotation of listing of recorded materials (stories, etc.) available and appropriate for very young visually handicapped children.

3. An annotated listing of literature available for very young visually handicapped children (check American Library Association Listing of Literature or other available listings). Focus of this listing should be items especially applicable and valuable to the visually handicapped child, age 6 and under.

4. Develop an articulation test for children functioning non-visually. Presently available tests (for adaptation) should be considered first.

5. Listing of First Chance model programs funded by BEH. All of these programs have special responsibility to disseminate and demonstrate. Language development is a key aspect of the program. This listing should be valuable for teachers.

Task 8 Survey of major preschool language development materials

Project Personnel Fay Leach

Purpose

The January 24-26, 1973 audiolinguistics meeting participants recommended adaptation of currently available programs for use with the visually handicapped over attempts to develop original materials. A survey of major preschool language development programs was undertaken.

Procedure

The procedure involved survey of commercial catalogues and review of materials displays.

Results

Information was obtained on more than 200 educational materials dealing with language development skills on the pre-school and primary level. This was shared with a committee working under the auspices of the State of Illinois Instructional Materials Center in a listening skills project. Efforts were coordinated with the committee in evaluating selected materials.

Few of the materials in early language development available commercially can be adapted for visually handicapped students without major changes. Five programs were purchased for additonal evaluation and consideration of adaptation.

Task 9 Advisory committee meeting: Early audiolinguistic skills development, August 21-22, 1973.

Project Leader Hilda Caton

Purpose

The purposes of the institute were as follows:

1. To make recommendations regarding types of materials needed by young visually handicapped children to develop audiolinguistic skills with special emphasis on experience relevant stories for this purpose.

2. To make recommendations regarding the kinds of formats in which stories could be presented most effectively. This would include the medium (recordings, braille, large type, or all three) as well as the actual format of the stories.

Participants

Mrs. Carol Cline, Resource Teacher for Visually Handicapped, Leon County Schools, Tallahassee, Florida

Dr. Verna Hart, Associate Professor, Coordinator, Early Childhood Education for the Handicapped, University of Pittsburgh, Pittsburgh, Pennsylvania

Mrs. Pamela Hoffman, Director, Pre-School Program, Dallas Services for the Visually Handicapped, Dallas, Texas

Mrs. Rosemary O'Brien, Director, Program for the Visually Handicapped, Montgomery County Schools, Rockville, Maryland

Miss Hilda Caton, Institute Coordinator, American Printing House for the Blind, Louisville, Kentucky

Mr. John F. Cardinale, Educational Materials Research and Development Assistant, American Printing House for the Blind, Louisville, Kentucky

Results

The participants used the following procedures for meeting the purposes of the institute:

1. Specific terms related to the purposes of the project were defined. These terms were:
   a. Early audiolinguistic skills - those aural/oral language skills which are developed by six in normally functioning children.
   b. Young visually handicapped children - children functioning at an MA of 6 years or below
   c. Stories - for purposes of this project, the term "stories" will include short rhymes, and musical jingles as well as the normally accepted definition of story.

d. Experience relevant stories - stories about activities which are within the realm of a young visually handicapped child's experience or understanding, i.e., stories about his daily activities, daily living skills, etc.

2. Specific problems of young visually handicapped children relevant to the development of early audiolinguistic skills were discussed.

3. Sample stories developed at APH were reviewed.

4. An outline of recommendations for developing experience relevant stories was prepared by the committee.

5. Oral recommendations regarding the sample stories developed at APH were made by the participants.

The meeting resulted in the presentation of recommendations for story development, general recommendations, story specifications, priorities, priorities for story development, and recommendations related to the establishment of a permanent consultative committee to the project. These five categories of recommendations will be reported individually in the remainder of this report.

Recommendations for story development: Specific recommendations for the development of experience relevant stories for visually handicapped children were as follows:

1. The committee prepared a written summary of recommendations (attached to this report) for the development of experience relevant stories. They felt that the stories should be geared to the developmental or functioning level of the child rather than to a chronological age level. Stories on the following levels were recommended:

a. Level I - Stories for children who receive sound, but do not recognize it.
b. Level II - Stories for children who have receptive ability (recognize sound), but little expressive language.
c. Level III - Stories for children who have expressive and receptive language, but few concepts (generally an MA of 3 years).

2. The committee further recommended that the stories cover sensory, manipulative, and cognitive aspects of development. Specific topics in these areas which should be used for stories are listed in the attached outline.

3. The committee recommended that perhaps one short tape be developed for Levels I and II and that the major emphasis be placed on the development of stories for Level III.

4. The committee also included a list of materials which are designed for use by sighted children and recommended that they be reviewed in terms of possible adaptation for visually handicapped children.

The committee listened to five stories which were developed and recorded at APH. These stories represented two categories: (1) stories incorporating manipulative tasks, and (2) stories about blind children. They then made the following recommendations regarding the stories incorporating manipulative tasks:

1. The concept of including manipulative tasks in stories is good.
2. The sample stories contained too many tasks in one story. One manipulative task for each story would be more appropriate.
3. The vocabulary of the sample stories was on a much higher level than the manipulative tasks the child was asked to perform. The vocabulary should be simple and repetitive.
4. The manipulative tasks were at an appropriate level for stories to be included in this project.

The committee felt that the stories about blind children were inappropriate at the preschool level. They felt that stories of this type would be more appropriate at the third or fourth grade level.

General recommendations: In addition to recommendations made for the experience relevant stories, the committee made the following recommendations which would apply to the project in general:

1. Stories should be produced in recorded form preferably on cassette tapes.

2. Commercially available materials should be reviewed and consideration be given to adapting them for use by visually handicapped children before any attempt is made to write new stories.

3. If commercially available materials do not emcompass all concepts listed in the outline accompanying this report, consideration should then be given to developing stories which would include those concepts omitted.

4. One short tape should be developed for Level I and one short tape for Level II to give teachers and parents examples and ideas for expansion.

5. The major emphasis in development of materials should be placed on Level III. This level might include a set of several tapes.

Story specifications: The committee prepared the following list of specifications for both adapted stories which might be written especially for the project:

1. The stories should include much simple, repetitive vocabulary.

2. The stories should be short and contain short rhymes and jingles.

3. The stories should be designed so as to involve students actively i.e., they should involve manipulative tasks such as stacking or stringing, activities of daily living such as hairbrushing or toothbrushing, etc.

4. Stories on the beginning level should involve much interaction with one person, i.e., actual manipulation of the child's hands, arms, etc.

5. The stories should be about the things a child experiences daily rather than about more abstract concepts.

6. The stories should definitely include music and variation of the voices of the characters.

Priorities for story development: The following priorities were given for the development of the materials recommended by the committee:

1. First priority should be given to the review and adaptation of commercially available materials which include the concepts and activities listed in the outline accompanying this report.

2. Following the adaptation of these materials, consideration should be given to the writing of stories to include concepts and activities not included in the adaptations.

3. The ultimate long range goal might be to develop an entire set of materials which would be assembled in Peabody Language Development Kit type format. This would include cassettes, audio flash cards, puppets, and lesson cards.

Recommendations related to a consultative committee: At the conclusion of the institute, it was decided that a permanent consultative to the project staff involved in the development of these materials was needed. The recommendations related to this committee were:

1. An overall consultant, or chief consultant to the project, should be appointed to give guidance and consultation to the entire Early Audiolinguistic Skills Project.

2. Consideration should be given to the establishment of a permanent consultative committee to the project composed of persons who are knowledgeable and experienced in this area.

3. The permanent consultative committee should meet at a later date to draw up exact specifications for the project.

	Level I Child Receives Sound but Doesn't Recognize	Level II Child has Receptive but Little Expressive Language	Level III Child has Expressive Language with Few Concepts (M.A. 3 yrs.)
Materials could cover sensory, manipulative, and cognitive aspects Media: Cassettes Audio Flash cards Puppets Lesson cards including goal materials needed Procedures Ultimately to be assembled in Peabody type kits for different M.A. levels	Activities for: Care and comfort of child Talk to child (Adapt Northcott) Structure Activities with a beginning and end Tactual stimulation rubbing Sound identification and localization Kinesthetic - put child through motions - move him from place to place Identify odors Visual tracking fixation	Songs and rhymes: Act out the words having to do with Body image Simple ADL toothbrush hand wash dressing eating Simple objects toys materials Interaction with people Short stories having to do with: ADL Daily schedules Personal experiences Getting dirty Sand Water Grass Leaves Snow Mud Rain Sequences Beginning and end Beginning, middle, and end Several steps	Activities would incorporate tearing, pasting, cutting, ADL, painting, textures, etc., while teaching concepts about myself, family, and community Myself: Body concept, clothes, toys, up, down, who, what, on, under, in, big, little, fast, slow, colors (red, brown, blue, orange, black, green, yellow), tall, short, hard, soft Model request and answers: I want a drink of water. Do you want some juice? Yes, No What's your name? ____________ Do you want this or this? _____ Two people activities which will lead to pretending, puppet play Family and Home: parents, siblings, pets, relatives, rooms, and furnishings, activities engages in throughout the day (playing, eating, toileting, etc.) Community: Vocabulary and concepts appropriate for trips to store, doctor, nursery school, bakery, on bus.

Level I

No recept.

Northcott

Ira Gordon's
"Baby Learning through
Baby Play"
St. Martin's Press

Mike Theus
"Parent Program of Infant
Stimulation for Visually
Handicapped Children
University of Texas
PhD Dissertation

"Memphis Project"
Publications
Memphis State
University Department
of Special Education

Level II

No Express.

Hap Palmer records

Ella Jankins records

Level III

Express.

Sounds I Can Hear

Noisy Books

Eye gate
"sight and sound
discovery trips"

Selected puppets
Duso Kits

Shari Lewis
"Listen and Think"
"Knowing and Naming
Books"
"What's in Mommy's
Pocketbook"

with concrete objects
rather than cardboard

"Touch Me Book"

Task 10 Advisory committee meeting: auditory and oral language skills project, June 5-7, 1974

Project Leader Fay Leach

Purpose

The purpose of this meeting was to review educational materials being developed and to discuss the project's progress and plans.

Participants

Dr. Verna Hart, Coordinator, Early Childhood Education for the Handicapped, University of Pittsburgh, Pittsburgh, Pennsylvania
Mrs. Carol Cline, Resource Teacher, Program for Visually Handicapped, Astoria Park Elementary School, Tallahassee, Florida
Mrs. Pamela Hoffman, Pre-School Program, Dallas Services for Blind Children, Dallas, Texas
Mrs. Kathryn Horton, Chief, Language Development Program, Bill Wilkerson Speech and Hearing Center, Nashville, Tennessee
Mrs. Kay Loss, Language Program, Arkansas School for the Blind, Little Rock, Arkansas
Mrs. Rosemary O'Brien, Coordinator, Program for the Visually Handicapped, Montgomery County Schools, Rockville, Maryland
Miss Eleanor Pester, Teacher, Program for the Visually Handicapped, Northwest Indiana Special Educational Cooperative, Highland, Indiana
Miss Hilda Caton, Educational Materials Research and Development Specialist, American Printing House for the Blind, Louisville, Kentucky
Dr. Fay Leach, Educational Materials Research and Development Specialist, American Printing House for the Blind, Louisville, Kentucky

Results

The committee reviewed the following prototypes and printed scripts:

Printed materials:

1. Six scripts and lesson cards based on the Headstart Books as adapted by Pam Hoffman
2. Five scripts and lesson cards based on stories from the Memphis Project and Sensory Stories as adapted by Eleanor Pester
3. Activity cards as rewritten by Fay Leach from materials by students at the University of Pittsburgh

Recorded materials:

1. Three cassette tapes from The Noisy Books which had been adapted by Hilda Caton
2. Sample tapes of student-made adult demonstration tapes which were accompanied by suggested activities (print format). These were done by students at the University of Pittsburgh.

3. A tape of activity songs for young visually handicapped children which had been prepared by Ethel Merwin.
4. Guidebook drafts prepared by Fay Leach

An organizational chart was developed to clarify the goals of the materials at each of the first four functional levels. This chart gave an expanded description of the target population, and defined the present level of functioning, projected level of skills, and child's responses.

General and specific suggestions for materials development were given. Materials for review were suggested for Levels IV and V.

General suggestions for development of the materials:

1. Ethnic groups should be considered in the content of the materials.
2. References to body parts should include appropriate names for genitals.
3. A reference section should be included with materials.
4. A "library" of sound should be included. This is to include sounds used in the tapes and a general list of sound for young children who have visual impairment. Sounds used in each tape should also be repeated at the end of the tape.
5. The materials box or kit should have a handle for easy carrying.
6. Materials should be indexed - use a color coding system with one color for each level.
7. Tapes should not be divided into levels but the activity cards should be divided according to levels.
8. The activity cards and guidebook materials should be hole punched for flexible arrangements in using.

Suggestions concerning the guidebooks:

1. In an introductory section, the developmental process should be defined and an outline of the units of materials given. The levels should be described.
2. The guidebook needs to be as flexible as possible.
3. It is important to overemphasize the length of time it takes to reach goals - "at a later state you will see -----."
4. A ladder type of booklet could be used so that parents aren't overwhelmed.
5. Included in the guidebook should be a discussion of the fact that what is done may be boring to the parent, but not to the child. Children enjoy familiarity, repetition.
6. The parents should be advised to set aside periods of time to use the materials.
7. The teaching of language concepts while using normal, daily routine activities should be emphasized.
8. Maintaining attention should be the criteria for selecting listening activities.

9. The guidebooks could be in the form of hole punched leaflet series which could be inserted in a loose leaf notebook binder along with punched activity cards.

10. Illustrations should include black children and other ethnic groups.

11. The introduction should stress that here are some helps or some things to do with the child over a period of time.

12. Very simple language should be used in the guidebook.

13. A reference section should be included.

Suggestions concerning the development of the tapes:

1. Male and female personnel should be involved in the recording.

2. Stories should include sound effects; these sounds should be repeated at the end of each tape. In levels I, II, and III, the actual sounds should be used. In levels IV and V music can be substituted for some of the sound effects.

3. There should be definite endings to each of the stories for the children - example: "and that's the end of Muffin's stay in the country."

4. Each adult-oriented tape should have a short introduction. The introduction will point up things which the adult should listen for in the tape. In the body of the tape there should be short interjections which highlight what is being taught, i.e. "this is one way you can talk to your child while bathing him." Questions might be asked, such as; "did you notice?" A tone index cue should be used to indicate these interjections.

5. There should be only one activity on a side of the tape.

6. Ethel Merwin's tape should have the music with words on one side and music without words on the other. This will allow the child to provide his own words. Written score should accompany the tape.

Suggestions for the activity cards:

1. The following formats were suggested:

   Priority I
      Why?
      What can be used?
      How to do it?
      What else?
      Where else?
   Priority II
      Purpose
      Suggested materials. If available, use ---
      Directions
      Additional activities
      Additional materials

2. There should be many activities designed to augment each tape.

3. Each activity card should focus on only one activity or goal.

Recommendations for Contents of Tapes

	Level I	Level II	Level III	Level IV
Adult oriented topics (at least one progressive sequence of a similar or related activity should be developed for each level.)	1. playing with toys 2. playing in the kitchen 3. the bath 4. dressing 5. a trip in a car or a bus	1. a trip to the grocery 2. hand washing 3. dressing the child 4. riding in a car or a bus with daddy 5. daily routines with different family members - these tapes would relate to sequences - an activity with a beginning, middle, and end	1. a trip to the grocery 2. dressing 3. a walk to the playground	1. the laundry compare sizes, colors shapes 2. dinner with daddy and mother sharing, taking turns, passing, asking for - please that's mine, his, yours
Child oriented tapes		Ethel Merwin Tapes Headstart Audio Tapes Noisy Books Memphis Project Tapes Sound Tapes - to include environmental sounds which might frighten child (i.e., jack hammer, lawn mower, vacuum cleaner, police siren, squealing of brakes, air brakes on bus, fire bell, air conditioner, furnace fan, fan.) Recording is to be used to help child learn not to fear these sounds. Sensory Stories		

Recommendations for Contents of Tapes

	Level I	Level II	Level III	Level IV
Input Guidelines (what is presented to child)	Use the word "child" rather than "baby" Use repetition Present only a few concepts Use short, simple sentences Include some males, females blacks, etc. Label actions or movements Present what is environmentally familiar Highlight inflections, stress, label Gear to child who is not talking Use statements and commands rather than questions Present highly rhythmic activities, nursery rhymes Have child responding--both baby and older child Manipulate child through movement	Focus on the development of expressive but not necessarily verbal skills Use a continuum of receptive language Alert the adult to an acceptance of approximations Focus on increased verbal skills Reflect the here and now--the environmentally familiar Reinforce the child's vocalizations--put these into simple context Use songs, simple ditties, rhymes	Stress simple concepts from the child's immediate environment Focus on concrete objects or concepts which can be demonstrated such as size, shape, big, little Present different meanings and usages for one word Give example of daily routines such as a time to get up, time for lunch, schedule Present spatial relationships such as on, under, in Make child aware of auditory input Give a good model of syntax and response to questions	Deal with parts to whole relationships Give same names for different objects: bells whistles etc. Encourage body movement: bend backwards forward Deal with abstraction such as love Adult should facilitate interaction Expand concepts of front, back Deal more with abstractions but still demonstrate ones.
Output Guidelines (what is expected from child	Nothing is expected from the child--would like but responses are not demanded from child: Smile Babbling Attention & pleasure responses Anticipation Motor or preverbal response	Consistent verbal response to reach out tactually Consistent motor responses Gestures for yes, no Non-verbal responses Cessation of activity on sound presentation Imitation Touch, body reactions Response to commands Ability to differentiate vocalizations Two-word sentences Labeling objects Naming people	At beginning two word sentences and move to simple sentences Demonstration of understanding of concepts of concrete objects	Child progresses syntactically Child progresses in expanding vocabulary

Task 11 Feasibility study: Adaptation of the cassette slide program, "Rules for Talking to Your Child"

Project Personnel Fay Leach

Purpose

The cassette-slide program, "Rules for Talking to Your Child" was developed by the Bill Wilkerson Hearing and Speech Center. This cassette program was reviewed by the auditory and oral language skills project advisory committee January 24-26, 1973 with the recommendation that this program be considered for adaptation for use with visually handicapped children. The purpose of this feasibility study was to consider in detail the need and requirements for adaptation of this program.

Procedure

Three copies of the program were obtained for review purposes. An inhouse review committee composed of members from the Research Department, Editorial Department, and IMRC was formed. The cassette-slide program was given an intensive review. The series was also reviewed by the advisory committee members who specified guidelines for adaptation.

Results

The recommendations projected by the APH inhouse committee indicated that since this series was a valuable aid for adult group presentation, the most useful adaptation of this series was to present it in an illustrated printed format which could be used individually. Three guideline booklets were developed and reviewed. Subsequently, the booklets were revised to be better coordinated with other materials being developed in the auditory and oral language skills development project.

Guidelines for the development of the booklets were specified in a project review committee meeting, June 5-7, 1974. These booklets are to be illustrated Parent/Teacher guidebooks to be coordinated with and accompany the three basic units of auditory and oral language materials currently being developed. Drafts are now being prepared for reproducing and testing.

Task 12 Exploration of the feasibility of the development of an instructional materials manual on elementary auditory and oral language skills.

Project Personnel Fay Leach

Purpose

One of the needs identified in a survey of educational materials needs for multihandicapped visually impaired children was for information to assist the teacher in the use of materials and to demonstrate how developmentally to sequence materials in early auditory and oral language skills. The purpose of this task was to explore the feasibility of the development of an instructional materials manual.

Procedure

Curriculum guides were collected and persons working on curriculum materials were contacted. These materials were displayed and the need and feasibility of the development of a manual was discussed at an auditory and oral language skills project review committee workshop, January 24-26, 1974.

Results

Curriculum materials reviewed were of limited use for visually handicapped students. Curriculum materials were brief and incomplete. The review committee advised, however, that the development of an instructional materials manual was a long term project and the greatest need at present was the adaptation of currently available materials. A listing of the available materials in elementary auitory and oral language skills development was published in the elementary readiness listing published by the IMRC.

CHAPTER TEN

DEVELOPMENT OF BRAILLE READING MATERIALS

Efforts in the area of braille reading were directed at two goals. The first dealt with facilitation of learning braille reading by young visually impaired students. The second concerned development of materials to inhance skill levels after reading learning had occurred.

Definition of the first goal was achieved through an initial advisory group meeting. A later advisory group meeting refined this definition as well as reviewed progress in projects stimulated by the first meeting. Four projects were completed. A set of worksheets to develop tactual discrimination skills was developed and tested. An environmentally based reading readiness program developed by an experienced teacher was brought to production form through cycles of expert review and revision. A set of beginning braille drill materials developed by another braille teacher was prepared for production in the same manner. Finally, a set of objects to assist in beginning braille instruction was indentified and packaged and a manual written describing a variety of meaningful uses.

Two projects concerned the development of materials designed to enhance braille reading speed and accuracy. The first brought the materials to final development and subjected them to a field trial.

The second developed teacher training materials and also included a further field trial of the skill development materials.

Task 1 Advisory group meeting: Primary braille reading, 1970.

Project Leader Hilda Caton

Purpose

The purposes of the advisory group meeting were as follows:

1. To identify problems in the area of teaching of primary braille reading and to suggest some specific solutions to these problems.

2. To consider the materials now available for teaching primary braille reading, to determine whether or not these materials are adequately meeting the needs of visually handicapped children, and to make recommendations regarding the improvement of these materials.

3. To make recommendations regarding the types of materials needed, which are not available at the present time, to teach primary braille reading.

4. To evaluate materials which have been submitted to the American Printing House for publication.

5. To identify the role the American Printing House can most effectively play in providing needed materials.

6. To set priorities for attacking problems identified and for the development of materials.

Participants

Mrs. Estelle Hagood, Instructional Supervisor, Texas School for the Blind, Austin, Texas

Miss Freda Henderson, Curriculum Director, Tennessee School for the Blind, Nashville, Tennessee

Mrs. Ina Kurzhals, Acting Principal, Utah School for the Blind, Ogden, Utah

Dr. Evelyn Rex, Assistant Professor, Department of Special Education, Illinois State University, Normal, Illinois

Mrs. Sara Schell, Resource Teacher, Atlanta Public Schools, Atlanta, Georgia

Mrs. Betty Wommack, Instructional Supervisor, Kentucky School for the Blind, Louisville, Kentucky

Miss Hilda Caton, Coordinator of Institute, American Printing House for the Blind, Louisville, Kentucky

Results

This meeting resulted in the identification of problems related to the teaching of braille reading, the recommendation of approaches to be taken in teaching braille reading, and recommendations for materials development. These recommendations are reported below.

Problems identified: Several specific problems in the area of primary braille reading were identified which are unique to visually handicapped children. They are as follows:

1. Problems relating to the child's physical and emotional orientation to school and to the classroom
2. Problems related to the child's general concept development
3. Problems related to gross and fine motor development
4. Problems the child encounters in learning to work with reading materials; the use of books, etc.
5. Problems related to language development
6. Problems of assessment of the child's development in each of the areas listed above.

Approaches recommended--Reading readiness: Participants in the meeting felt that no one approach to the teaching of braille reading should be used. Emphasis was placed on the necessity for a variety of approaches which could be used in relation to the individual needs of each child. They also felt that the most important aspect in teaching beginning braille reading in general, was that the teacher must be concerned with word meaning and not with words alone. Therefore, much attention must be given to the development of concepts in the visually handicapped child which will enable him to find meaning in what he reads. These concepts must be developed in a sequential manner in order to prepare the child for the formal task of reading braille. The first steps in concept building are related to the first two problems stated above: (a) problems related to the child's physical and emotional orientation to school and the classroom, and (b) problems related to the child's general concept development as it is related to his interactions with his environment. Basically, it was felt that before a visually handicapped student learns to read, he must be provided with an interesting and stimulating environment in the classroom. The attitude of the teacher is vital to the development of this environment. She must acquaint the child with his environment, both in the classroom and outside the classroom, so that the proper concepts can be developed prior to the beginning of the formal reading instruction. This orientation to the environment would involve many field trips with specific purposes and the establishment of interest centers throughout the classroom which would stimulate the interest of the child in his environment.

Recommendations for materials development--reading readiness: Participants felt that the following materials were urgently needed in the area of reading readiness and recommended that they be developed by APH. These materials are listed in the order of their priority:

1. A guidebook for teachers in the area of reading readiness which would contain:
    a. suggested reading readiness activities for visually handicapped children
    b. lists of materials designed to overcome specific problems encountered by children who are learning to read braille
    c. lists of materials needed to develop the concepts needed by visually handicapped children in learning to read

d. list of the motor skills the child needs to have developed in order to begin reading and the types of activities and materials needed to develop these skills.

Such a guidebook had been written by Mrs. Ina Kurzhals, Utah School for the Blind, and the participants recommended that this be adapted and produced by APH. The participants also recommended that the special set of materials which accompany the guidebook be further developed by APH.

2. A collection of objects for teaching reading concepts to visually handicapped children accompanied by written instructions and suggestions to teachers as to how these materials could be used most effectively. The collection would contain objects suitable for teaching the following concepts:

- a. Motor development--objects to develop the realistic use of hands in preparation for reading braille
  - (1) Hand usage--gross motor development
    - (a) handling
    - (b) grasping
    - (c) holding
    - (d) releasing
  - (2) Finger dexterity--fine motor development
    - (a) grasping small objects
    - (b) exploring
    - (c) tracing
    - (d) examining
  - (3) Coordination of both hands
    - (a) use of both hands for handling, grasping picking, holding, releasing
    - (b) use of both hands in transferring objects
    - (c) use of both hands in assembling and disassembling
    - (d) use of one hand for a guide and the other hand for manipulation
    - (e) use of hand and fingers in opposition, i.e., cutting with scissors, screwing, moving objects in and out from the body
- b. Cognitive development--objects to be used to develop the process of thinking
  - (1) Objects for identification
  - (2) Objects which can be related to the environment and experiences of the child
  - (3) Objects for classification (sets)
    - (a) according to shape
    - (b) according to size
    - (c) according to texture
    - (d) according to weight
    - (e) according to function
    - (f) according to length
    - (g) according to thickness
  - (4) Objects for association, discrimination and comparison
    - (a) according to likeness
    - (b) according to difference
    - (c) according to function
  - (5) Objects to develop creative thinking
    - (a) recall of previous experiences in relation to specific objects

            - (b) story telling relation to objects
            - (c) listening for meaning in stories related to objects
        - (6) Objects to develop language usage
            - (a) vocabulary
                - i) naming of objects
                - ii) description of objects
                - iii) comparison of objects orally
            - (b) oral classification, association, and comparison of objects, i.e., indicating orally whether objects are round, square, rough, smooth, hard, soft, longer, shorter, harder, softer, etc.
            - (c) spatial description
                - i) up-down
                - ii) over-under
                - iii) right-left
                - iv) above-below
            - (d) interpretation
                - i) expressing relationships
                - ii) cause and effect
                - iii) predicting outcome
                - iv) developing sequence
    - c. Sensory development--objects to develop awareness and understanding of sounds
        - (1) Tactual development
            - (a) sort objects according to shape
            - (b) sort objects according to size
            - (c) sort objects according to texture
        - (2) Auditory development
            - (a) gross sounds
                - i) identification of sounds
                - ii) discrimination of sounds
            - (b) voice sounds
                - i) beginning letter sounds
                - ii) middle letter sounds
                - iii) ending letter sounds
                - iv) blends
                - v) rhyming sounds
    - d. Activities should be developed to give the child experience in working independently and, also, to give the teacher time to work with other children.
    - e. Many of the ideas and activities listed above could be extended into the beginning reading program by using the braille representation of the objects.

Approaches recommended--beginning reading: The discussion on beginning reading centered upon materials now being produced by APH and recommendations were related to these materials. In addition, two sets of beginning materials submitted to APH for review were discussed and recommendations regarding them were made.

Recommendations relating to materials now being produced by APH were limited to pre-primers, primers, and primary reading workbooks. The recommendations related to these materials were as follows:

1. Pre-primers and primers

Participants felt that these materials were effective in teaching beginning reading to some children if they were used with adequate supplementary aids. They felt that more attention should be given to the difficulties of the braille code; for example, use of the letter sign, etc., and to the format of these books when they are transcribed into braille. They also felt that the pre-primers and primers should be smaller in size.

2. Primary reading workbooks

Recommendations regarding the workbooks which are produced to accompany the pre-primers and primers were based upon the fact that the transcribing of these materials into braille results in a format which is extremely complicated and very difficult for young children to read or understand. Since much of the material in the primary inkprint workbooks consists of pictures or diagrams, the transcription into braille does not adequately convey the intended concept to the visually handicapped child. Therefore, the institute participants recommended that the primary workbooks to be produced this year be brailled on one side, and that they be bound so that the individual pages can be removed and used as consumable worksheets by the student. They further recommended that, in the future, the production of primary workbooks be discontinued by the American Printing House and that they be replaced by consumable worksheets designed to teach the necessary concepts and provide practice in the desired areas of reading.

Recommendations related to the materials which had been sent to APH for review were that they were not appropriate in their present form and that they be reviewed more thoroughly in terms of their possible adaptation.

Summary of recommendations for material development in reading readiness and beginning reading: Listed below is a summary of recommendations from this meeting:

A. Production of readiness materials, in the form of a teacher's guide with accompanying books for students, developed by Mrs. Ina Kurzhals.

B. Development of a set of objects, with accompanying teacher's instructions, to be used in teaching specific concepts of reading to visually handicapped children.

C. Development of sets of worksheets which are designed to develop specific skills and to overcome specific problems related to braille reading.

D. An assessment instrument should be developed which will give an indication of the child's readiness for beginning braille reading.

E. Touch and Tell readiness series, American Printing House for the Blind, should be expanded to include many more exercises of the type already included.

F. Word cards developed from the Dolch Word Lists should be produced, as well as brailled alphabet cards and adaptations of reading games.

G. Pre-primer and primer materials, programmed according to the difficulties of the braille code should be developed.

H. A bibliography of current reading series, stating their basic philosophy should be produced by the American Printing House for the Blind.

General recommendations: General recommendations were that the participants in the institute continue to serve as consultants to the project designed to develop materials in primary braille reading and that they meet at later dates to review materials as they are developed.

Task 2 Advisory group meeting: Primary braille meeting, 1972.

Project Leader Hilda Caton

Purpose

The purposes of the 1972 advisory group meeting were as follows:

1. To review recommendations for the development of materials for teaching primary braille reading made by participants in the 1970 advisory group meeting at APH.

2. To set priorities for the development of primary braille reading materials.

3. To evaluate materials presently under development by APH for revision.

4. To make recommendations for future development of primary braille reading materials.

Participants

Mrs. Marian Anderson, Teacher, Program for the Visually Impaired, Savannah Public Schools, Savannah, Georgia

Miss Freda Henderson, Curriculum Director, Tennessee School for the Blind, Nashville, Tennessee

Mrs. Ina Kurzhals, Curriculum Director, Utah School for the Blind, Ogden, Utah

Miss Eleanor Pester, Resource Teacher for Visually Impaired, Northwest Indiana Special Education Cooperative, Highland, Indiana

Miss Emma Rowe, Teacher, Program for the Visually Handicapped, Dade County Public Schools, Miami, Florida

Mrs. Sara Schell, Itinerant Teacher, Atlanta Public Schools, Atlanta, Georgia

Mrs. Jane Wegehoft, Primary Teacher, Illinois Braille and Sight Saving School, Jacksonville, Illinois

Miss Hilda Caton, Institute Coordinator, American Printing House for the Blind, Louisville, Kentucky

Results

The 1972 primary braille reading meeting resulted in the following recommendations by the participants:

A. After reviewing recommendations made in the 1970 primary braille reading meeting, the participants set the following priorities for development of materials by APH:
   1. The development of the reading readiness program originated by Mrs. Ina Kurzhals, Utah School for the Blind, should be given first priority. These materials should include a guidebook explaining the origin, philosophy, and implementation of the program; lesson plans; and tactual readiness books to be used by students.
   2. A collection of objects and an accompanying manual of instructions for teachers should receive next priority.
   3. A booklet for parents of pre-school visually handicapped children, based on lesson plans in the reading readiness program described above, should be developed.
   4. Two sets of worksheets to provide drill and reinforcement in problem areas specifically related to the braille code and problem areas specifically related to the reading process should be developed.

Priorities for recommendations three and four were not specifically set. It was generally agreed that these two sets of materials should be developed in the order which was most feasible in terms of APH staff time.

B. It was strongly recommended that consideration be given to the production of a set of braille drill materials developed by Mrs. Jane Wegehoft, Illinois Braille and Sight Saving School, Jacksonville, Illinois. These materials are primarily on the pre-primer and primer level, although certain parts can be used at higher levels if desired.

C. After reviewing materials, recommended in the 1970 primary braille reading group, which are presently under development at APH, participants in this meeting made the following recommendations:
   1. The reading readiness program originated by Mrs. Ina Kurzhals:
      a) The title should be as follows: A Tactual Road to Reading: A Developmental Program for Young Children.
      b) The editing and revision of the guidebook should be completed as planned.
      c) The revision and re-writing of the lesson plans should be completed as planned.
      d) Tactual Readiness Books for children which can be brailled or thermoformed should be produced by the American Printing House. Directions and patterns for making the remaining books should be provided by APH.
      e) When the revisions are completed, sets of the materials should be placed in a number of educational settings throughout the country for evaluation. Prior to the evaluation, a member of the APH staff whould meet with each of the evaluators to explain exact procedures to be followed.
      f) The materials should be presented to a number of teacher training programs for review and/or evaluation.

- g) After completion of the evaluation the materials should be revised and produced by APH.
- h) Following production, a series of workshops should be held in various sections of the country to demonstrate the use of the materials.

2. The collection of objects
   - a) The title of the collection should be as follows: Tangible Dictionary.
   - b) The collection of objects should be evaluated by expert teachers and objects judged to be unsuitable should be replaced by better items.
   - c) The manual of instructions for teachers should be completed.
   - d) The set of materials should be placed in appropriate educational settings for evaluation.
   - e) Revisions should be made and decisions made regarding need for further evaluation and/or production.
3. The book of information for parents of pre-school visually handicapped children
   - a) This book should be based, primarily, on selected lesson plans from the reading readiness program originated by Mrs. Ina Kurzhals.
   - b) Parents and community agencies involved in serving the visually handicapped should be involved in the review and evaluation of materials to be included in the book.
   - c) Information of this kind is urgently needed by parents of visually handicapped children and should be provided by APH.
4. Worksheets
   - a) Two types of worksheets should be developed to provide drill and reinforcement in these problem areas in braille reading:
     - (1) those related to the braille code
     - (2) those related to the reading process in general
   - b) Worksheets in the form of adaptations of pre-primer and primer workbooks should not be developed as previously recommended.
   - c) After development, the worksheets should be placed in appropriate educational programs for review and evaluation.
   - d) Revisions should be made and devisions made regarding the need for further evaluation and/or production.

D. Recommendations were made regarding the future development of primary braille reading materials by APH. These were as follows:

1. If possible, all primary braille reading materials developed by APH should be produced as an integrated set of materials which can be used in reading readiness and beginning reading programs throughout the country. Consumers should be allowed to purchase the entire set or individual parts as they are needed.
2. Participants in this meeting should continue to serve as a consulting group to assist the staff of APH in developing braille reading materials for visually handicapped children.

Task 3 Development of Tactual Discrimination Worksheets

Project Personnel Hilda Caton and Elenor Pester

Purpose

Accuracy in tactual discrimination is critical to learning by visually handicapped children who will be dependent on information gained through various tactual representations throughout their educational careers. As these children progress in educational programs, they will be required to interpret tactual representations in many subject areas such as diagrams and graphs in mathematics, raised line drawings and maps in social studies and geography, and braille code characters in reading.

Studies have shown that many problems exist among visually handicapped children in regard to their ability to make these discriminations. Ashcroft (1960) identified frequent reading errors arising from problems in the discrimination of braille code characters. Nolan and Kederis (1969) also noted problems in braille character recognition. Berla' (1972) studied the effects of physical size and complexity of metric figures on tactual discrimination performance of blind children and found the overall accuracy of performance to be low. Ziegler and Northup (1926) have shown that for common geometric figures (triangle, circle, square, rectangle) there is a threshold below which tactual figures cannot be recognized. Morris and Nolan (1963) have shown that the relative size of different textural patterns affects discrimination and/or recognition performance of blind children. Other studies (Lobb and Friend, 1967; Foulke and Warm, 1967; Owen and Brown, 1970; Warm, Clark, and Foulke, 1967) have pinpointed other problems in the discrimination of tactual figures by blind children. It has also been shown that specific training in tactual discrimination will improve the ability of visually handicapped children to discriminate tactually. Henderson (1967) and Umsted (1970) demonstrated that improvements in braille reading speed and accuracy resulted from specific instruction and training. Nolan and Kederis (1969) stressed the need for intense formal training in tactual perception as a part of any readiness program in tactual discrimination for visually handicapped children. However, few studies specifically relate to the effects of training on the ability of visually handicapped children to discriminate tactual figures other than braille characters.

The Tactual Discrimination Worksheets were developed in answer to some of the problems cited above. They are designed to provide visually handicapped children with experience and training in the discrimination of various forms of tactual stimuli. Specifically, they include training and drill in the discrimination of geometric forms in solid dot (filled in) and dotted outline patterns, raised lines in dotted patterns, angular figures in dotted patterns, and braille code characters. The tasks involved in the worksheets will be purely discriminatory in nature. At no time are students required to name geometric forms, kinds of lines or angular figures, or braille code characters.

Procedure

The procedures used in the development of the Tactual Discrimination Worksheets were directed toward the attainment of the following objectives:

1. To provide visually handicapped children with training and experience (drill) in the discrimination of the various forms of tactual stimuli which they will be required to interpret in most subject areas during a major portion of their educational careers.

2. To develop a general tactual readiness for young visually handicapped children including training and experience in the discrimination of geometric forms in solid dot and dotted outline patterns, lines in dotted patterns, angular figures, and braille characters.

3. To provide materials with which visually handicapped children can work independently following adequate periods of instruction.

Specific procedures were as follows:

1. Specifications for the worksheets were written during January-February, 1973. The bases of these specifications were as follows:
(a) The specification for worksheets for geometric forms were based on information from analyses of commercially available reading readiness materials (Stocker, 1970; Duncan, 1969; Kurzhals and Caton, 1972) and on materials in reading readiness developed by teachers for their own use. Geometric forms occurring most frequently in these materials were included in the worksheets.
(b) The specifications for the worksheets for lines were based on information gained through analyses of the same materials and on information regarding the use of lines in mathematics textbooks.
(c) The specifications for worksheets for angular figures were based on an analyses of the braille code to identify characters whose outlines formed specific angular figures. Only angular figures formed by outlines of braille code characters were used.
(d) Specifications for the worksheets for braille code characters were based on one-cell characters in Grade Two Braille. For the worksheets for geometric forms, line, and angular figures, all possible combinations of the figures were used. The order of presentation of the figures on individual worksheets was established through the use of random tables. The order of presentation of the braille code characters was based on studies by Ashcroft (1960) and Kederis (1962) which identified most frequent errors made in braille reading and ranked one-cell braille characters in order of difficulty. Kederis' study also lists braille characters which are most easily confused. This information was also used in designing individual worksheets. Studies by the Uniform Type Committee (1915) and by Flannigan (1969) were also reviewed to provide background for the development of the worksheets for the braille code characters.

2. An initial review of the materials by an in-house committee composed of staff members of the Educational Research, Development and Reference Group of APH was conducted in the Spring of 1973.

3. During the period April 1-May 31, 1973, revisions based on this review were made and the revised set of materials was reviewed again by this committee. At that time, final revisions based on the second review by the in-house committee were made.

4. The primary braille reading consulting group met at APH on June 11-12, 1973 for an initial evaluation of the materials.

5. Revisions based on this evaluation were made and the materials were prepared for the final field evaluation during the period June 1-August 31, 1973.

6. The final evaluation of the worksheets was conducted during November-December, 1973.

7. Data from the final field evaluation was analyzed during January-February, 1974.

8. The worksheets were revised on the basis of the results of the data analysis. The worksheets within each group, i.e., geometric forms, were recorded on the basis of difficulty and additional worksheets were generated for especially difficult items.

9. The worksheets were then prepared for production.

Materials description

The Tactual Discrimination Worksheets are consumable paper sheets on which geometric and other punctographic forms are embossed. They are designed to be used as drill-type materials to provide potential braille readers with practice in making simple tactual discriminations independently. The set of worksheets is composed of four parts as follows:

Part I Geometric Forms - Simple geometric forms in raised dotted outline figures and solid (filled in) dotted figures are included. The shapes presented are: circle, square, triangle, rectangle, and diamond. Two different sizes are used.

Part II Lines-horizontal, vertical, and diagonal are included. They are presented as broken lines, lines of various lengths, and lines related to other lines.

Part III Angular Figures - These figures are made up of simple angular forms found in braille code characters. Two different sizes, both larger than braille code characters, are presented.

The sequence of presentation of the materials was determined through testing for difficulty. However, this sequence of presentation may not be appropriate for all students. Some students may be able to start on a more advanced level or skip levels. Other students may need additional practice on one level before going on to the next.

Basically, the tasks for each of the four sets are the same. Students are asked to:

1. Find the figure in a row of figures which is different.
2. Find the two figures in a row of figures which are the same.
3. Find the figure(s) in a row of figures which is the same as a stimulus figure at the beginning of the line.
4. Find the break(s) in a raised line.

The worksheets are designed so that, after the student discriminates among the forms, he can indicate his answer by marking or erasing the dots with a hard plastic crayon. By erasing the dots with his crayon, the student can later go back over his answers and even check his own paper for mistakes.

The worksheets are accompanied by a pamphlet of instructions which contains a description of the specific tasks required of the student on each page. At least four tasks of each type are presented with additional items where more practice seems to be needed. The tasks for each exercise include only those which the student can perform independently after instruction.

Subjects

Subjects were 89 students in eight residential schools for visually handicapped children. Data relative to grade placement of subjects is given in Table 1.

Table 1

Grade Placement of Subjects

Grade	Number of Subjects
Kindergarten	20
First Grade	22
Second Grade	20
Third Grade	27
Total	89

Results

The data analysis consisted of the computation of the mean, standard deviation, range, and percent passing the total number of items for each of the four parts of the worksheets. The data were not analyzed for all four parts combined since the nature of each of the four parts did not lend itself to such analysis. Tables 2 - 5 present summaries of these data.

Table 2

Data Summary for Geometric Forms

Grade	Mean Correct	S. D.	Range	Percent Passing
K	20.45	5.19	14-30	64
1	23.80	4.42	16-31	74
2	21.09	5.74	9-31	66
3	23.93	3.87	16-31	75
Total	22.42	4.8	9-31	70

Table 3

Data Summary for Lines

Grade	Mean Correct	S. D.	Range	Percent Passing
K	25.80	6.45	15-41	50
1	36.95	7.45	27-51	71
2	32.41	10.68	11-48	62
3	40.11	8.52	21-51	77
Total	36.69	10.27	11-51	70

Table 4

Data Summary for Angular Figures

Grade	Mean Correct	S. D.	Range	Percent Passing
K	18.30	6.83	5-29	46
1	27.20	6.26	13-37	68
2	25.63	8.92	8-38	64
3	30.00	7.69	14-39	75
Total	25.37	8.6	5-39	63

Table 5

Data Summary for Braille Code

Grade	Mean Correct	S. D.	Range	Percent Passing
K	8.35	6.83	0-29	17
1	33.10	8.91	17-47	68
2	36.36	10.05	10-48	76
3	40.29	8.65	14-48	84
Total	29.85	15.47	0-48	62

Inspection of these tables indicates that, in general, visually handicapped students do not perform at an extremely high level in the discrimination of tactual representations. This would seem to imply that there is a need for training materials in this area. Also, based on the grade level means and percent passing, there seems to be a gradual increase in the ability of students to discriminate tactually as they progress in educational programs. In order to determine whether this difference was significant, analyses of variance for each of the four parts of the worksheets was conducted. Results of these analyses are given in Tables 6-9.

Table 6

Analysis of Variance for Grade Level Differences
Geometric Forms

Source	DF	SS	MS	F
Between	3	215.80	71.93	3.09
Within	85	1963.82	23.10	
Total	88	2476.84		

Not significant

Table 7

Analysis of Variance for Grade Level Differences
Lines

Source	DF	SS	MS	F
Between	3	2575.84	989.31	11.72*
Within	85	6130.13	72.11	
Total	88	8705.97		

*Significant at .01 level

Table 8

Analysis of Variance for Grade Level Differences
Angular Figures

Source	DF	SS	MS	F
Between	3	1639.40	546.47	9.60*
Within	85	4838.49	56.92	
Total	88	6477.89		

*Significant at .01 level

Table 9

Analysis of Variance for Grade Level Differences
Braille Code

Source	DF	SS	MS	F
Between	3	13295.11	4431.7	52.05*
Within	85	7745.07	87.59	
Total	88	20740.18		

*Significant at .01 level

These analyses indicate that there is a significant difference, by grade level, in the ability of students to perform the discriminations in the lines, angular figures, and braille code. There was no significant difference in the ability of students to perform the discrimination in the geometric forms. When viewed in the context of the means for the different grade levels, it appears that the difference in ability is progressive - from kingergarten through third grade. There is some discrepancy in the performance of second grade students. The standard deviations for this group show an unusual amount of variation in their performance. This can probably be attributed to the fact that subjects were taken from different schools and a substantially different performance by subjects from one school could result in such a difference. The absence of a significant difference in performance on the geometric forms could possibly be accounted for by the fact that students in kindergarten and first grade usually receive direct training in the discrimination of these forms and do not receive training in the discrimination of the other forms. Thus, one would expect their performance on the geometric forms to be superior to that on the other forms. An examination of the means for geometric forms reveals that there is actually very little difference in the performance of kindergarten and first grade students and that of students at higher levels, thus, supporting this assumption. Means for the performance on lines, angular figures, and braille code, show that the performance of kindergarten students is consistently lower than those for other grade levels.

Since these analyses indicate that there is an increase in the ability of students to make tactual discriminations of the type represented in the worksheets as they progress in school, it appears that training or, at least exposure to materials of this type, is necessary. Therefore, the Tactual Discrimination Worksheets could perform a valuable function in the training of visually handicapped children in tactual discrimination.

In addition to the analyses just described, item difficulties for each of the items in each of the four parts of the worksheets were computed. These item difficulties were then used to order the items within each of the four parts. The following sections of this report contain summaries of the item difficulties for each of the four parts of the Tactual Discrimination Worksheets.

For Part I - Geometric Forms, item difficulties were computed in the following categories:

1. Discriminations based on the shape of the figure
   a. Matching to a stimulus figure
   b. Finding figures which were alike
   c. Finding figure which was different

2. Discriminations based on the size of the figure
   a. Finding figure which was different
   b. Matching to a stimulus figure

3. Discriminations based on the form of tactual representation
   a. Dotted outline figures
   b. Solid (filled in) dotted figures

Item difficulties in each of the categories are given in Table 10.

Table 10

Item Difficulties for Geometric Forms

Category	Item Difficulty
1. Discriminations based on shape	85.65
a. Matching to a stimulus figure	88.26
b. Finding figures which are alike	83.76
c. Finding figures which are different	82.32
2. Discriminations based on size	65.56
a. Finding figures which are different	69.34
b. Matching to a stimulus	61.78
3. Discriminations based on form of tactual representation	75.72
a. Dotted outline figures	76.65
b. Solid (filled in) dotted figures	74.79

The results of these analyses show, conclusively, that discriminations made on the basis of shape are significantly less difficult than those based on the size of the figure. When the basis for discrimination was the shape of the figure, the task of matching to a stimulus figure was easiest, followed by the task of finding figures which were alike, and the task of finding figures which were different was most difficult. In the category based on the size of the figure, subjects were not asked to find figures which were alike because this task was too difficult for the purposes of the study. In this category, the task of finding figures which were different was easiest, while matching to a stimulus figure was hardest.

Some figures in the geometric forms were presented as dotted outline figures and some were presented as solid (filled in) dotted figures. The item difficulties computed for these two forms indicated that the difference between the difficulty in discriminating these forms were not great. The dotted outline figures were slightly less difficult than the solid figures, but other variables such as the number of figures presented in each form, etc., could have accounted for this difference.

Using the item difficulties given in Table 10, the worksheets in Part I - Geometric Forms, were reordered on the basis of their difficulty and additional items were added to provide more practice on the more difficult items. Items requiring shape discrimination were presented first, followed by items requiring size discrimination. Tasks within each of these categories were also ordered according to difficulty. Since there was relatively little difference in the difficulty in discriminating dotted outline figures and solid figures, both were included in each of the categories just described.

For Part 2 - Lines, the item difficulties were computed in the following categories:

1. Discrimination of breaks in a line
    a. Discrimination of breaks in horizontal lines
    b. Discrimination of breaks in vertical lines

2. Discrimination of positions of lines - horizontal, vertical, diagonal
    a. Finding the line which is different
    b. Finding the line which matches a stimulus figure

3. Discrimination of lengths of line segments
    a. Find the segment which is different (longer or shorter) when segments are arranged vertically
    b. Find the segment which is different (longer or shorter) when segments are arranged horizontally
        (1) Horizontal line segments in a row
        (2) Horizontal line segments one above the other

4. Discrimination of spatial relationships of lines
    a. Finding the short line which is in a different position than other short lines in relation to one long line.
        (1) One long horizontal line with short horizontal lines above and below it.
        (2) One long vertical line with short vertical lines on the right or left side.
    b. Finding the long vertical line with short vertical lines on the right or left side which matches a stimulus figure.

Item difficulties for each of these categories are given in Table 11.

Table 11 shows that the discrimination of breaks in a line is the easiest task, followed by discrimination of positions of line, lengths of lines, and spatial relationships; in that order. It appears that the task of discrimination of spatial relationships is a particularly difficult task for visually handicapped children. Since spatial relationships are especially important in the reading of braille, it would seem that it might be profitable to provide more training and practice in this area.

Table 11

Item Difficulties for Lines

Categories	Item Difficulty
1. Discrimination of breaks in a line	76.13
a. Horizontal lines	79.81
b. Vertical lines	72.46
2. Discrimination of positions of lines	68.80
a. Finding the line which is different	69.27
b. Finding the line which matches a stimulus	68.16
3. Discrimination of lengths of line segments	66.78
a. Finding the segments which are different (vertical)	69.96
b. Finding segments which are different (horizontal)	60.40
(1) Horizontal segments one above the other	65.11
(2) Horizontal segments in a row	58.05
4. Discrimination of spatial relationships of lines	59.46
a. Finding the short line which in a different position than others in relation to a long line	65.40
(1) Long horizontal line with short lines above and below	73.01
(2) Long vertical line with short line or right or left side	57.79
b. Finding vertical line with short line on right or left side which matches a stimulus figure	47.58

As in the case of Part I - Geometric Forms, the item difficulties for lines were used to reorder the worksheets in order of difficult from easy to difficult. Additional items were also added for especially difficult items. For Part 3 - Angular Figures, item difficulties were computed in the following categories:

1. Discriminations based on the shape of the figure
   a. Matching to a stimulus figure
   b. Finding figures which are different
   c. Finding figures which are alike

2. Discriminations based on the size of the figure
   a. Finding figure which is different
   b. Matching to a stimulus figure

Item difficulties in each of the categories are given in Table 12.

These item difficulties indicate a pattern which is similar to that found in Part I - Geometric Forms in that discriminations based on shape are less difficult than those based on size. However, the difference in difficulty is not as great in the Angular Figures and some individual tasks within the categories were reversed in terms of difficulty, i.e., finding figures which were different and finding figures which were alike. Also, the difficulty of the items, overall, in the Angular Figures was greater than in the Geometric Forms. Again, the item difficulties were used to reorder the worksheets and additional items were added when necessary.

Table 12

Item Difficulties for Angular Figures

Category	Item Difficulty
1. Discrimination based on shape	67.86
a. Matching to a stimulus figure	72.21
b. Finding figure which is different	71.18
c. Finding figures which are alike	60.19
2. Discriminations based on size	64.18
a. Finding figure which is different	75.17
b. Matching to a stimulus figure	53.20

For Part IV - Braille Code, item difficulties were computed in the following categories:

1. Matching to a stimulus figure
2. Finding figures which are alike
3. Finding figure which is different

Item difficulties for each of the categories are given in Table 13.

Table 13

Item Difficulties for Braille Code

Category	Item Difficulty
1. Matching to a stimulus figure	64.66
2. Finding figures which are alike	63.41
3. Finding figure which is different	61.91

As might be expected, the difficulty of items in the braille code was somewhat greater than for other parts of the worksheets, although individual items in other parts were more difficult. Since most of the students at the kindergarten level had not been exposed to the braille code, their performance in this area was very poor. This performance, of course, is reflected in the item difficulties and contributes to the fact that the overall performance in this area is poor. However, almost all students performed poorly in this area which would indicate the necessity for more drill and training. The Braille Code worksheets were also reordered and additional items were added, based on the item difficulties obtained.

Overall item difficulties for the four parts of the set of worksheets are given in Table 14.

The four parts of the Tactual Discrimination Worksheets were ordered on the basis of the item difficulties above. It is quite obvious that the Geometric Forms were more easily discriminated than other figures. This is probably true, as stated earlier, because visually handicapped students receive more practice in this type of discrimination than other types, at an early age. However, all parts of the worksheets were relatively difficult in terms of discrimination. This would seem to indicate that there is a definite need for further training which would be provided by the Tactual Discrimination Worksheets.

Table 14

Overall Item Difficulties

Category	Item Difficulty
1. Geometric Forms	74.67
2. Lines	67.07
3. Angular Figures	66.39
4. Braille Code	63.45

Summary

The development and evaluation of the Tactual Discrimination Worksheets has been described in this report. The worksheets were developed on the basis of the most current research available in relation to the tactual perception abilities of visually handicapped children. The results of an extensive field evaluation indicate that these children do, in fact, need materials which will provide them with training and experience in various types of tactual discrimination. The worksheets were designed for this purpose and data from the evaluation were used to order them appropriately for use by visually handicapped children. At the present time, the Tactual Discrimination Worksheets are being prepared for production by APH.

Task 4 A Tactual Road to Reading

Project Personnel Hilda Caton, Ina Kurzhals, and Eleanor Pester

Purpose

A Tactual Road to Reading is an environmentally based readiness curriculum for braille reading. This curriculum concerns activities and experiences which most normal pre-school children encounter incidentally in the ordinary course of events. However, since the majority of visually handicapped children do not normally have these experiences, it is necessary to provide them in school programs in order to assure an adequate background for understanding the concepts they encounter in a reading program. For this reason, each lesson concerns a different environmental experience, language experience, or experience with books. Each represents a unified instructional approach stressing and integrating concept development in the tactile, oral language, and motor areas. The lessons are designed so that teachers may use them as models to adapt to local conditions.

A Tactual Road to Reading was developed by Mrs. Ina Kurzhals, Utah School for the Blind, through actual use over a period of approximately twenty years. However, the program was not formally organized and written until 1971 at which time an initial draft of the program was developed. The formal organization and writing of the program were direct results of recommendations of participants in the Primary Braille Reading meeting held at APH in November, 1970 (Task 1). Participants in this group identified materials in the area of reading readiness as those most critically needed at the present time and recommended that the APH IMRC work with Mrs. Kurzhals in organizing her program so that it could be used effectively by other teachers.

Procedure

During 1971, staff members of the IMRC worked with Mrs. Kurzhals in the development of the entire program. This entailed the organization and writing of lesson plans and the construction of multiple copies of the materials in preparation for a field evaluation.

After the development of the entire program was complete, it was reviewed, in 1971, by 5 expert teachers in the area of braille reading and by members of the Primary Braille Reading Advisory Group which was established during the 1970 meeting. Revisions based upon these reviews were made during the spring and summer of 1972. The revised materials were then subjected to a final review by participants in the 1972 meeting of the advisory group (Task 2). Additional revisions, based on the recommendations of this group, were made and the materials were prepared for the formal field evaluation.

During 1973, the materials were placed in the field with 13 teachers of visually handicapped children in both public and residential school programs. These programs were as follows:

Dallas Independent Schools, Dallas, Texas

Dallas Services for Visually Handicapped Children, Dallas, Texas

San Antonio Independent Schools, San Antonio, Texas

Northeast Independent School District, San Antonio, Texas

Dade County Public Schools, Miami, Florida

Florida School for the Deaf and the Blind, St. Augustine, Florida

Montgomery County Schools, Rockville, Maryland

Wisconsin School for the Visually Handicapped, Janesville, Wisconsin

Springfield Public Schools, Springfield, Illinois

Illinois State University, Normal, Illinois

Teachers in these programs reviewed and evaluated the entire set of materials in actual use with children. They were furnished with an extensive forced-choice review questionnaire on which they were asked to respond to specific questions related to the philosophy, organization, description of the program, and description of the materials in the guidebook; to the philosophy, organization, objectives, materials and resources, lesson content, and evaluation procedures in the lesson plans; and to the design, content, purpose, and production procedures for the books to be used by students. In addition, individual books related to skills development were reviewed in the same manner. Also, a pamphlet entitled Aid for Teachers, which provides patterns and directions for making additional books, was reviewed. After responding "yes" or "no" to the questions in each area, the evaluators were asked to make suggestions for revisions where they appeared to be needed. A criterion of 70% positive responses was set for the acceptance of a specific item in its present form. If this criterion was not met, the item was revised and improved, if possible, or eliminated if this was not possible.

Materials

A Tactual Road to Reading in its final form, consists of the following items:

1. A Guidebook, which contains a statement of the origin and philosophy of the program and a description of the materials contained in the program.

2. Five pamphlets, four containing lesson plans and one containing diagrams and patterns for making parts of the program materials which are not produced by APH. The pamphlets are organized into the following categories:

    Pamphlet I - Learning Through the Environment
    Pamphlet II - Learning Through Spoken Language
    Pamphlet III - Learning Through Hand Skills
    Pamphlet IV - Learning Through Books
    Pamphlet V - Aids for Teachers

3. Thirty-six Tactual Readiness Books to be used by children. These books are organized into the following categories:

    a) Analytical/Interpretive Books - braille stories about things which have actually been experienced by children.
    b) Skill Books - designed to develop skills of following a line, location on a page, shape, etc.
    c) Library Books - interesting stories for childrnn to read for fun.
    d) Structured Books - introduce sentences which carry over to the next line, paragraphs that carry over to the next page, etc.

Other Tactual Readiness Books which are a part of the program, but not produced by APH are:

a) Texture Books - introduce children to the discrimination of textures, objects, etc. as well as providing them with books which contain toys and other things with which they are familiar.
b) Books of Objects - also contain textures and objects, but put more emphasis on discrimination.
c) Child's Own Books - books made by the children themselves.
d) The Surprise Book - introduces the use of phonics in a reading program. The book contains an envelope on each page with an object for which the child has to give the beginning sound.

4. Cassette Tape - contains a description of the program and its development by Mrs. Ina Kurzhals, originator of the program.

A Tactual Road to Reading is a flexible program which is appropriate for use in a variety of situations. Listed below are some situations in which it can be appropriately used:

1. The program can be used by teachers in reading readiness programs for visually handicapped children.

2. The program can be used by parents, in the home, to provide environmental experiences which develop concepts needed for later success in reading programs.

3. The program can be used by educators of multi-handicapped children who require direct and concrete experiences both in the environment and with educational materials.

Subjects

During the evaluation of the materials, teachers used the complete set with 69 students in grades K-7 with chronological ages of 2 1/2 years to 11 years. The criterion for selection of students for participation was their reading level rather than chronological age. The reading levels which were acceptable were reading readiness and beginning reading through the pre-primer level. Older students who were reading at these levels were included because the materials are highly motivational and considered to be especially appropriate for these students.

Results

Results of the evaluation indicated that the materials were effective at the pre-reading level and that some students who had not responded to other methods of learning to read braille responded to this method and made definite progress. Responses to the evaluation questionnaire were tabulated and those items which did not meet the criterion of 70% in relation to acceptability were revised, based on the recommendations of the evaluators, if possible. Items which were not acceptable and could not be revised were eliminated. Responses related specifically to the Tactual Readiness Books indicated that they were appropriate in their initial form and, therefore, revision for these materials was not required.

Concluding statement

All revisions on these materials were completed in August, 1973. They were presented to the Education Aids Committee, which is composed of ex-officio trustees of APH, for approval in October, 1973. At that time, the materials were approved and turned over to the editorial and production departments of APH for final preparation for distribution. These materials are now in production.

Task 5 My Fingers Do Good Work

Project Personnel Hilda Caton, Jane Wegehoft, and Eleanor Pester

Purpose

The set of beginning braille drill materials, My Fingers Do Good Work, was developed by Mrs. Jane Wegehoft, Illinois Braille and Sight Saving School. Basically, these materials are designed to improve the student's ability to discriminate tactually, to recognize and remember tactual configurations, and to listen to and follow directions in story situations. They are not designed to function as a complete braille reading readiness program. Also, the materials are not specifically designed to teach the names of braille code characters. However, some teachers may wish to use certain lessons for that purpose.

In order to use the materials effectively, students will need to participate in a more complete reading readiness program. Such a program should include experiences in the manipulation of many books and objects; learning concepts of size in terms of big, bigger, short, shorter, etc.; developing auditory perception and discrimination skills (particularly awareness of meanings, interpretations, and letter sounds); and many experiences in the environment to build necessary concepts. Also, students will need to have developed some skill in moving the hands along a line from left to right with rhythm and smoothness, moving from line to line, top to bottom, etc. Other aspects of the complete program should include the knowledge that the words are read across the line and from line to line, and that they say something - that there is content and meaning. In addition, students must have had many varied experiences with books of all kinds. As the student is completing a broad readiness program such as this and as he is developing skills needed in a pre-primer program, he may make use of the lessons in My Fingers Do Good Work.

The production of these materials was recommended in the 1972 Primary Braille Reading Advisory Group meeting (Task 2) after an initial review by the members of this group. After the initial review, Mrs. Wegehoft revised the materials according to specifications drawn up by the group. The need for the materials was based on the fact that very few materials for primary braille drill are available at this time and, those that are available do not provide for motivation and interest on the part of students. Since My Fingers Do Good Work utilizes stories and game-like activities, it was felt that they would be more appropriate for children at the beginning levels of braille reading than any materials now available.

Procedure

The procedure for the development of the materials was as follows:

1. Initially, the materials were reviewed by the Primary Braille Reading Consulting Group. The committee recommended a number of revisions which Mrs. Wegehoft completed in the Spring of 1973.

2. During the period September - November, 1973, the materials were placed in the field with six expert teachers of visually handicapped children for an in-depth evaluation. These evaluators were furnished with a questionnaire on which they were asked to respond to questions related to both the introduction and to the individual lesson plans. Evaluators were asked to respond "yes" or "no" to individual items and to make suggestions for revision if the items were not acceptable. The criterion of acceptability was a positive response from 70% of the evaluators. If possible, items were revised on the basis of recommendations by the evaluators. If revisions were not possible, items were deleted.

3. The evaluation questionnaires were analyzed during the period January - March, 1974 and a meeting was held with Mrs. Wegehoft to review the results of the evaluation and to discuss possible revisions of the materials.

4. Additional revisions, based on the evaluation, were made by Mrs. Wegehoft during April, 1974.

5. The materials were then placed in the field for a final evaluation in June, 1974. Evaluators were again furnished with the evaluation questionnaire (attached to this report) and requested to respond with "yes" or "no" to each item. Suggestions for revision were also requested. The criterion for acceptability was the same as for the initial evaluation.

6. Final revisions, based on this evaluation, were completed in August, 1974 and the materials prepared for production.

Materials

The set of materials, My Fingers Do Good Work, consists of two series of small individual books and a set of simple, two-dimensional figures. The two series are entitled, Story Workbooks and Activity Workbooks. They are used to introduce visually handicapped students to the braille code and to the skills in tactual discrimination needed to serve as an introduction to a pre-primer program in braille reading. These series are accompanied by a pamphlet containing instructions for presenting each individual lesson, including imaginative stories and games.

There are twenty Story Workbooks. These books consist of braille alphabet characters. The upper left hand corner of each page presents a braille alphabet character enclosed in a box. This symbol serves as the stimulus figure for the exercises on the page. There are three lines of braille alphabet characters on each page. Each line contains some characters which match the stimulus figure and some which do not. The task in each lesson is to find the characters which match the stimulus or those which are different from the stimulus. After the correct symbols are found, most of the stories lead to a culminating activity in which the symbols are used to make a specific design or picture. This picture can be used in various activities related to the story or to additional stories.

There are twelve Activity Workbooks. These workbooks contain enlarged braille alphabet configurations in both solid line and dotted line form and, also, braille alphabet letters in standard size. These configurations are presented in gradually decreasing sizes until the size of the actual braille character is reached. Each page contains configurations of the same size. Solid line figures are presented first with the largest size on the first page and figures of decreasing size on subsequent pages. Next, dotted line figures are presented in the same manner. Finally, braille characters are presented. In most lessons, each line contains configurations which are the same except for one which is different. The task in the lesson is to find the one figure in each line which is different.

The set of lesson guides which is provided to assist teachers in the use of the books makes use of short imaginative stories and game-like activities in presenting the tasks to the student. In order to prepare the student for the lesson, a list of concepts related to the story and activities is provided at the beginning of each lesson. Materials needed for each lesson are also listed.

Figures provided with the set of materials may be used with the lessons in both series of books. They are simple, two-dimensional figures. They are not intended to be exact representations of real animals or people. Therefore, teachers should provide an opportunity for students to examine the real object represented by the figure whenever possible and should explain differences between the figure and the real object.

Results

Results of the evaluations indicated that the materials were appropriate for use in beginning braille drill activities. Following the initial review, revisions were made for those items which did not meet the criterion of 70% positive response. Results of the final review indicated that these revisions were acceptable and all items were considered appropriate. In regards to the question regarding the production of the materials by APH, 100% of the evaluators responded positively.

Concluding Statement

The set of materials, My Fingers Do Good Work, was developed by Mrs. Jane Wegehoft, Illinois Braille and Sight Saving School. The production of these materials by APH was recommended by the Primary Braille Reading Advisory Group which consists of expert teachers and administrators in the field of braille reading. The set of materials was adapted by Mrs. Wegehoft for use on a national level. They were then subjected to an initial evaluation, revision, and a final evaluation by teachers of visually handicapped children. The results of the evaluations indicated that the materials were appropriate for their stated purpose, that of improving the student's ability to discriminate tactually, to recognize and remember tactual configurations, and to listen to and follow directions in stories. The materials are now being prepared for production by APH.

Task 6 Tactual Aids for Reading: A collection of objects for use in developing beginning reading skills

Project Personnel Hilda Caton

Purpose

Tactual Aids for Reading (TAR) consists of a collection of 175 objects for use in reading readiness and/or beginning reading programs for visually handicapped children. It is accompanied by a manual, "Guidelines for Teachers", containing suggestions for using the objects. The major purpose of TAR is to provide teachers of visually handicapped children with a variety of objects to be used in teaching beginning reading and to provide guidelines for their use. Basically, the TAR materials are intended to:

1. Provide materials which will stimulate interest and curiosity about real things in the environment and, thus, an understanding of certain concepts encountered in reading.
2. Provide materials which will develop an awareness of the importance of tactual discrimination skills.
3. Provide a variety of interesting and motivational activities for teaching specific reading skills (i.e., phonics).
4. Provide materials which will supplement and/or replace illustrative materials in inkprint textbooks.

The need for the TAR materials was established through two meetings related to primary braille reading (Tasks 1 and 2) which were held at APH. Participants in these meetings made recommendations regarding the most critically needed materials in the teaching of beginning braille reading and in reading readiness for braille. In addition to making specific recommendations for materials, these participants set priorities for their development. A collection of objects such as that contained in the TAR was second in priority only to the development of a complete reading readiness program for braille reading. Since the participants in these meetings were experts in the teaching of braille reading, it was determined that the need for these materials was validly established.

Procedure

The procedure used for the initial development of the TAR collection of objects was that of textbook analysis. Objects considered appropriate for the collection were chosen through a careful analysis of several basal reading textbook series. The items included were selected on the basis of their applicability to more than one reading series. Pre-primers, primers, and grade one readers from four leading basal reading series were analyzed. These series were chosen for analysis because: (1) They represent the two most prevalent approaches used in the teaching of reading today - the linguistic approach and the phonics approach; and (2) They are produced in braille by APH. The four series analyzed were:

1. The Betts Basic Readers, American Book Company, 1963
2. Basic Reading Series, Lippincott, 1963
3. 360 Reading Series, Ginn and Company, 1969
4. New Basic Readers, Scott Foresman Company, 1962

Both teachers' editions and students' editions of these series were included. The analysis consisted of the careful examination of pictures in students' editions and examination of both pictures and directions for teaching a lesson in the teachers' editions. Using the pictures and the teacher's directions, specific objects were identified which would be needed in presenting the lessons to visually handicapped children. Lists of objects needed for each reading series were made and compared so that objects common to all four series could be selected for inclusion in the collection. Criteria used for the inclusion of specific objects in the TAR collections were:

1. the usefulness of the object in presenting lesson to the student
2. the availability of objects which were highly discriminable tactually
3. the difficulty teachers may face in obtaining the objects
4. the practicality of including the objects in the collection

Many objects which were identified as being useful for all series analyzed were easily available to the teacher in the classroom or school and, for this reason, were not included.

Using the procedure just described, an initial collection of approximately 500 objects was assembled. These objects were then reviewed by the Primary Braille Reading Advisory Group and by a group of experienced teachers of visually handicapped children. Using the four criteria listed above, they eliminated objects which were inappropriate. Those objects which were retained comprised the set used for the final field evaluation.

For the final evaluation, the TAR materials were placed in the field with 11 teachers of visually handicapped children in both public and residential school programs. These programs were:

Dallas Independent Schools, Dallas, Texas

Northeast Independent School District, San Antonio, Texas

San Antonio Independent School District, San Antonio, Texas

Dade County Public Schools, Miami, Florida

Florida School for the Deaf and the Blind, St. Augustine, Florida

Wisconsin School for the Visually Handicapped, Janesville, Wisconsin

Montgomery County Schools, Rockville, Maryland

Illinois State University, Normal, Illinois

The collection of objects was evaluated in terms of the acceptability of each object for use in beginning reading or reading readiness programs. The criteria for acceptability were the tactual attributes of the object. If the critical attributes of the object were clear and easily discriminable and if the object was durable in use by students, the object was retained for the collection. If the attributes were not clear and discriminable, the evaluators suggested improvements. If the objects were not considered to be acceptable by at least 70% of the evaluators, they were replaced by better representations of the same object if possible. If better representations were not available, the object was eliminated from the collection.

The "Guidelines for Teachers" manual was evaluated in terms of its usefulness in helping teachers use the objects to present reading skills to visually handicapped children and in terms of its applicability to more than one reading series. A criterion of acceptance by 70% of the evaluators was used for the "Guidelines for Teachers".

Materials description

The set consists of a collection of 175 objects, identified through extensive textbook analysis and evaluation as being appropriate aids for use in beginning reading programs, and a pamphlet entitled "Guidelines for Teachers" which offers suggestions for using the collection.

The actual composition of the TAR collection of objects may vary at times because of the availability of certain items. Objects which are included in the collection will be those identified as being most acceptable through extensive evaluation by expert teachers of visually handicapped students. The collection contains objects in such categories as animals, fruits, vegetables, furniture, cars and trucks, etc. A complete list of the objects from which those contained in the collection are chosen can be found in the appendices of "Guidelines for Teachers".

In addition to the collection of objects and the manual, "Guidelines for Teachers", the set contains four large containers, 13" wide, 9 1/4" high, and 12 3/4" deep with a shelf for each container which fits horizontally across the middle. Four drawer-type inserts are provided for each container. These inserts are 4" high, 6" wide, and 12" deep. Additional containers may be purchased with each set, or separately.

Subjects

The TAR materials were used with 43 visually handicapped children whose chronological ages ranged from 6 years to 15 years. These students were enrolled in grades K-7. They were selected on the basis of their reading levels which were reading readiness to beginning reading. All subjects were braille readers or potential braille readers. Other handicapping conditions, in addition to blindness, were noted for 7 of the students.

Results

Results of the evaluation indicated that 100% of the evaluators felt that the TAR materials were needed and valuable in the teaching of beginning reading and reading readiness to visually handicapped children. The evaluators stated that the collection of objects adequately met its stated purposes. They further stated that the manual "Guidelines for Teachers" was useful in providing suggestions for using the objects and that they considered the guidelines to be appropriate for use with any basal reading series now in use.

Concluding statement

Following the evaluation, the TAR materials were revised. These revisions were based on the recommendations of the evaluators and consisted of replacing inappropriate objects with better representations and including additional activities in the manual, "Guidelines for Teachers". The TAR set of materials is now being produced by APH. These materials are pictured and described in a brochure included in Appendix B.

Task 7 Materials to increase braille code recognition skills

Project Personnel Richard Umsted

Purpose

The average rate of braille reading has been found to be two to three times slower than the average rate for print reading (Nolan & Kederis, 1969). The braille reading habits of a child are established by the time he reaches the third grade level in school according to Fertsch (1946) and this is when most of his formal instruction in braille ends. As silent reading receives more emphasis within the curriculum, the braille reader begins to fall behind his sighted peer group in rate of reading. Nolan and Kederis have determined that the mechanical aspects of reading are still problem areas in the upper elementary grades and that the reading rates of braille readers level off by the ninth grade. These authors have concluded that skill in the recognition of the characters that make up the braille code is critical for development of rapid reading rates.

This assumption was tested by Henderson (1967) who determined what effect training for speed and accuracy in the recognition of the 55 single-cell characters within the braille code would have on the reading process of pupils in grades three to six. The experimental group decreased its reading time for the characters by a statistically significant 42 percent and decreased its mean number of errors by 84 percent. Training, therefore, effectively produces an improvement in braille character recognition and an increased efficiency of the total reading process of students in the elementary grades.

The purpose of this study was to develop materials which would increase the speed and accuracy of recognition of the one-cell whole word and part-word signs, the two-cell contractions, and the short-form words in English Braille. Additionally, the study assessed the extent to which use of such materials with high school students would improve their braille reading speed and accuracy.

Materials

The training materials developed included 20 Braille Code Recognition Lists (BCRL) containing 176 randomly assigned contractions and short-form words. In addition, 12 Discrimination Lessons (DL) consisting of repeated practice and specific drill exercises were developed to help increase the accuracy and reading rate of the various code symbols. Three formats were used to offer variety to the exercises. These lessons were constructed with relevance to the errors which, according to the literature (Ashcroft, 1960; Nolan and Kederis, 1969) occur most frequently. The frequency of individual items was not determined proportionately in terms of the error indexes of the previous studies, but emphasis was given to missed dots, reversals, and alignment errors.

The criteria of the effects of training included measures of both oral and silent reading. Two forms of an Oral Reading Test were developed which were 705 words in length. These tests were at the 9-10 grade level of readability and included all 189 contractions and short-form words in English Braille. Silent reading was measured through use of Forms A, B, and C of the Diagnostic Reading Tests: Survey Section.

Subjects

The 72 subjects in the study were selected from the high school grades of three state residential schools for the blind in the Midwest. All of them had used braille as their primary reading medium for approximately three years and were free from any secondary handicaps which would have adversely affected reading performance. Scores for rate of reading and comprehension on a silent reading test were used to divide all of the students who met the selecting criteria into high, medium, and low levels of reading as shown in Table 1. The subjects were then designated by random sampling into either the experimental group or the control group.

Table 1

Distribution of Students by Reading Speed

High (113-186 wpm)

wpm	N	percent
175-186	5	5.5
155-169	3	3.3
130-144	8	8.8
113-126	13	14.3
Total	29	31.9

Medium (71-109 wpm)

wpm	N	percent
101-109	11	12.0
90-99	7	7.7
81-86	8	8.8
71-79	7	7.7
Total	33	36.2

Low (30-69 wpm)

wpm	N	percent
63-69	8	8.8
51-58	14	15.4
40-48	4	4.4
30-37	3	3.3
Total	29	31.9

Procedure

All subjects were pre-tested for reading speed and accuracy using the Oral Reading Test, Form A and BCRL #1. Students were also pre-tested with Form A, Diagnostic Reading Test, Survey Section. One week later they were tested with Form B, under motivating conditions designed to yield maximum scores. Scores from this testing were used to form the three reading groups: high, medium, and low described in Table 1.

Experimental subjects were then given 15 days training by experienced teachers especially trained for this study. Training consisted of systematic practice with the BCRLs and DLs where students completed the two exercises under instructions to improve time and accuracy scores for code recognition daily. Self-competition was the motivation used and students were given results of their efforts which were charted daily over the 15 day training period. All subjects were then post-tested using the Oral Reading Test, Form B, BCRL #10, and the Diagnostic Reading Test, Survey Section, Form C.

Results

The braille code recognition training program resulted in a highly significant gain for the experimental group in both speed and accuracy in code recognition when compared with the controls. Errors on the pre-test (BCRL #1) were 17 for the experimentals and 18 for the controls. This constituted a 10% error level in code recognition for both groups. On the post-test, the experimental group decreased their mean error score by 60 percent, while the decrease for the control group was only 11 percent. Analysis of variance showed these different rates of decrease to be significant at the .01 level of confidence. Means and standard deviations for the groups appear on Table 2.

Table 2

Means and Standard Deviations for Errors in Braille Code Recognition as Measured by BCRL #1 and BCRL #10

		Pretest		Posttest		Change Score	
Group	N	Mean	S.D.	Mean	S.D.	Mean	S.D.
Experimental							
High	12	16.17	11.92	4.50	5.04	11.67	9.79
Medium	12	16.25	11.12	9.75	8.23	6.50	10.26
Low	12	16.00	10.69	6.08	7.74	10.92	9.18
Total	36	16.14	10.93	6.44	7.33	9.70	9.75
Control							
High	12	18.42	11.85	17.33	11.52	1.09	5.74
Medium	12	14.83	10.73	13.08	11.48	1.75	4.18
Low	12	19.42	14.37	16.33	11.49	3.09	5.44
Total	36	17.56	12.21	15.58	11.31	1.98	5.08

Similar results were attained for speed of recognition. From the pre-test to the post-test the experimental group increased their recognition rate almost three times more than the control group. Analysis of variance showed these differences significant at the .01 level of confidence. Gains in rate were greatest for the low reading level followed by the middle level and the high level in that order. Means and standard deviations for rates are given in Table 3.

Table 3

Means and Standard Deviations for Reading Times
(in Minutes) for Braille Code Recognition

		Pretest		Posttest		Change Score	
Group	N	Mean	S.D.	Mean	S.D.	Mean	S.D.
Experimental							
High	12	4.13	1.12	1.94	.60	2.19	.73
Medium	12	5.16	1.26	2.26	.40	2.90	.93
Low	12	7.27	2.78	3.15	.87	4.12	2.10
Total	36	5.52	2.25	2.45	.82	3.07	1.57
Control							
High	12	5.06	.96	4.16	.71	.90	.76
Medium	12	5.40	2.15	4.31	1.20	1.09	1.05
Low	12	7.16	2.24	5.90	2.16	1.26	1.45
Total	36	5.87	2.04	4.79	2.08	1.08	1.10

Although the expected significant differences on the braille code recognition tests were obtained, of greater importance was the effect such results had on the oral braille reading skill of these high school students. The experimental group improved their accuracy by 17 percent on the Oral Reading Test. Although this improvement was not statistically significant, it was double the improvement shown by the control group. The only statistically significant difference on the accuracy of oral reading was from pre-test to post-test. Means and standard deviations for accuracy of oral reading appear in Table 4.

Table 4

Means and Standard Deviations for Errors on the Oral Reading Test

		Pretest		Posttest		Change Score	
Group	N	Mean	S.D.	Mean	S.D.	Mean	S.D.
Experimental							
High	12	22.67	22.27	18.17	16.82	4.50	6.71
Medium	12	21.25	12.19	20.50	12.16	.75	7.69
Low	12	28.33	23.58	21.17	17.24	7.17	15.30
Total	36	24.08	19.67	19.94	15.18	4.14	10.65
Control							
High	12	19.42	14.09	20.08	16.21	- .67	6.01
Medium	12	23.75	22.53	19.50	16.28	4.25	8.56
Low	12	33.58	29.51	30.17	30.29	3.42	8.06
Total	36	25.58	23.06	23.25	21.88	2.33	7.72

A significant gain in oral reading speed was attained by the high level experimental reading group only. Means and standard deviations for rate of oral reading are shown in Table 5.

Table 5

Means and Standard Deviations on Rates of Oral Reading in Words per Minute

Group	N	Pretest Mean	Pretest S.D.	Posttest Mean	Posttest S.D.	Change Score Mean	Change Score S.D.
Experimental							
High	12	118.99	29.45	130.44	30.58	11.44	6.53
Medium	12	95.51	23.99	96.82	19.62	1.31	6.72
Low	12	58.07	16.68	65.29	17.01	7.22	6.77
Total	36	90.86	34.48	97.52	35.12	6.66	7.73
Control							
High	12	111.78	24.01	115.27	23.42	3.49	8.43
Medium	12	84.93	17.08	87.42	15.42	2.49	5.29
Low	12	52.43	14.58	57.53	15.62	5.10	2.97
Total	36	83.05	30.74	86.74	29.93	3.70	5.92

Training in speed and accuracy in code recognition had no significant effect on comprehension in silent reading. However, a significant gain in silent reading rates was demonstrated. The experimental group increased its rate 30 percent as compared to 10 percent for controls, a significantly different (.01 level) rate of increase. More importantly, effects were much greater at the lower reading levels with the low level experimental group showing an increase of 62 percent and the medium level an increase of 33 percent.

Table 6

Means and Standard Deviations of Time (in Words per Minute) for the Silent Reading Test

Group	N	Pretest Mean	Pretest S.D.	Posttest Mean	Posttest S.D.	Change Score Mean	Change Score S.D.
Experimental							
High	12	148.71	21.86	173.48	28.28	24.78	31.13
Medium	12	89.92	12.77	119.51	18.80	29.59	11.68
Low	12	52.36	9.30	84.91	16.80	32.55	12.51
Total	36	97.00	42.96	125.97	42.63	28.97	20.18
Control							
High	12	133.04	22.85	137.33	20.76	4.29	34.83
Medium	12	86.23	14.13	98.62	16.37	12.39	9.92
Low	12	55.94	8.85	68.43	10.70	12.49	4.34
Total	36	91.74	35.85	101.46	32.76	9.73	20.82

Discussion

Apparently educators have erroneously assumed that a braille reader has achieved his optimum capacity for reading speed and accuracy by the time he reaches high school. Possibly because of the demands of the high school curriculum and the lack of previous research and materials, little demand or effort has been made to insure that maximum reading speed has been attained through drill in accuracy and speed in recognition of the braille code members. Some students with sufficient desire and drive do develop their own approach for increasing their reading speed but a concentrated period of intensive instruction, such as provided in the present study, would possibly be more efficient. The progress made by the experimental subjects at various reading levels in this study suggests that many braille readers would profit from the use of similar procedures and materials.

Educators should give serious consideration to the need for yearly evaluation and instruction in the accuracy and rate of recognition of the braille code symbols regardless of the school grade level. Even when it appears that a student knows the code and has a respectable reading speed in braille, continued reappraisal and encouragement for improvement are recommended. The results of this study imply that after minimum instruction with specially designed materials, the speed and efficiency of the reading process can be improved for many braille readers.

Conclusions

The results of this study indicate, that for high school students, training in speed and accuracy in recognition of the elements of the braille code results in improvement in both oral and silent reading. The Braille Code Recognition Materials are currently produced and distributed by APH. These materials are pictured and described in a brochure included in Appendix B.

Task 8 Classroom use of the Braille Code Recognition Materials

Project Personnel Roy Brothers

Purpose

The development and evaluation of the Braille Code Recognition Materials was described in the preceding report in Task 7. Use of these materials in training high school students in speed and accuracy in recognition of elements of the braille code resulted in improvement of both oral and silent reading.

Special efforts are often needed to insure that positive results of experimental research are carried over into actual classroom practice. The goal of the APH IMRC has been to promote the efficient use of educational materials that have proven utility for the education of visually handicapped students. However, in some instances teachers need the opportunity to receive instruction in the specific techniques necessary to fully utilize newly developed materials.

The present study represented an effort by three agencies of the Special Education Instructional Materials Center (SEIMC) Network. The materials used were a development of the IMRC. Specific instructions for use of the materials were developed by the Michigan State University Instructional Materials Center (MSU IMC), and arrangement for the workshop experience and use of the materials in the classroom was coordinated by the Illinois Instructional Materials Center.

The primary purpose of the project was to develop an instructional kit which would prepare teachers to use the Braille Code Recognition (BCR) Materials developed and validated by Umsted (1970) and Henderson (1967). Subsequent evaluations were to determine the effectiveness of the teacher instructions and the effect of materials use on the braille reading skills of visually handicapped students. The present account has focused on the use of the materials in the classooom.

Materials

The Braille Code Recognition Materials used in the study basically consisted of braille code recognition lists and braille code exercises. The twenty different lists contained 176 randomly assigned contractions and short-form words in English Braille. Each contraction and short-form word appeared only once on each list. Since 13 of the lower cell signs have a dual meaning depending on their use in a sentence, the print copy reflected both meanings (i.e. bb and be; cc and con; dd and dis). In taking into account the 13 additional meanings that were represented, the total number of contractions and short-form words in each list was 189. In order to orient the student to the relative position of the dots each word and/or contraction in each of the 20 braille lists was preceded by a full braille cell. The BCR lists were prepared in both braille and print form.

Braille Code Exercises were also prepared in both print and braille form. Twelve discrimination-type lessons consisting of repeated practice and specific drill exercises were designed to help increase accuracy and the reading rate of the code symbols. Three different formats were used to offer variety to the drill exercises. The lessons were constructed to emphasize the errors which occur most frequently in reading with emphasis on missed dots, reversals, and alignment errors.

A percentage accurate table and graph material were included in the set as a motivational aid. The percentage accurate table was used by the teacher to facilitate a conversion of error scores to percent accurate scores for each BCR list administered. Potentially the table converted from 1 to 63 errors to a percentage of accuracy. Print and braille graphing materials were used by the teacher and/or student to chart daily progress. Since time scores were recorded for each day it was possible to account for daily increases in the speed of recognition.

Revised forms A and B of the Diagnostic Reading Test, Survey Section (Committee on Diagnostic Reading Tests, 1952) were utilized to obtain pre and posttest measures of silent reading speed for each student. Each form of the test was 1,500 words in length and was followed by twenty multiple-choice questions which sampled recall and comprehension of facts contained in the story. The reading level of the material was reported as being appropriate for grades 7 through 12.

Braille code recognition lists were utilized to obtain daily accuracy scores and rates for reading orally the 176 contractions represented on each list.

Subjects

Teacher participants: Under the auspices of the Illinois State Department of Education, teachers in the Chicago, Illinois area were given an opportunity to attend a braille reading workshop. Attendance was voluntary and in this respect the participants were not randomly selected. A total of 17 teachers attended the workshop and received instructions in the use of the materials. Of these, 12 were then serving students who could make immediate use of the materials.

Student participants: Teachers attending the instructional in-service training session were encouraged to try any or all of the materials with their students. In this respect the sample of students was dependent upon the teacher sample. Controls over such factors as grade level, age, years of experience in reading braille, or intelligence were not possible. Nevertheless the sample of Ss was a desirable one if generalizations about uses of the materials were to be made.

A total of 24 students used part or all of the BCR materials. Of these four were categorized as ungraded; seven were enrolled in grades 4-6; ten were enrolled in grades 7-8; and three were enrolled in grade 12. The students ranged in age from 10 years-6 months to 22 years-0 months. The median age for the group was 13 years-4 months.

The students' prior experience with braille ranged from 6 months to 11 years. The mean number of years experience in reading braille was 5.5 years. Of those students participating 21% had less than two years experience in reading braille.

Teachers were asked to rate the students according to academic functioning. Of those given a rating, five were categorized as functioning above grade level, eight were rated at grade level, and eight were rated at below grade level.

Procedure

An inservice workshop was conducted in Chicago, Illinois during the spring of 1973. The purpose of the inservice was to introduce and thoroughly familiarize teachers with the use of the materials. Teachers were also instructed in the administration of pre and post silent reading tests. The timing and scoring procedures associated with administration of the BCR lists was emphasized. The field trial or classroom use of the materials was scheduled to immediately follow inservice instruction.

It was recommended that the materials be used for a three week period or fifteen class days. The length of individual sessions was not to exceed 30 minutes per day. It was further recommended that the first and last days be set aside for administration of Forms A and B of the silent reading test. The instructional plan for the thirteen intervening days followed a common pattern. First, one of the BCR lists was administered and the time required to read all contractions was noted. Second, specific lines that contained errors were reread. Finally remediation was provided. The procedure of rereading error lines was advocated since two types of error seemed possible. An error could be perceptual in the nature of a reversal, missed dot, or alignment problem, or it could be the result of a limited knowledge of the code. The type of error would determine to some extent the type of remediation provided. Remediation techniques were left at the option of the teacher. If the error was perceptual remediation focused on drills requiring finer tactual discriminations, and the use of the Braille Code Exercises was encouraged. Whenever time permitted additional BCR lists were administered and the same follow-up procedures were used. In some instances a reader was able to read two or more lists within the course of a single period.

An effort was made to motivate each student to a higher level of performance. The number of errors made on each list was converted to a percentage of accuracy and was charted at the end of each session. In the case of those students who had already achieved a high level of accuracy, speed was emphasized. Students were encouraged to chart their own progress whenever possible. Each student competed against himself to achieve lower error rates and higher recognition speeds.

Results

Prior studies by Henderson (1967) and Umsted (1970) indicated that practice in brailled code recognition contributed to increased braille reading efficiency. The two basic indicators of student improvement were: a) increased accuracy in recognizing braille contractions, word-signs, and short-form words; and b) increased speed in recognizing the symbols. The ultimate criterion was an increased reading rate without loss of comprehension.

Accuracy of recognition: The mean pre-experiment accuracy score of the group was 88.7% which represented 19.86 errors. The mean post-experiment score of accuracy was 97.4% which represented 3.63 errors. Using a *t*-statistic for correlated observations the mean difference was significant at the .01 level of confidence ($t = 4.72$, $df = 23$, $p < .01$). During the trial period the mean number of recognition errors decreased by approximately 82%.

One method used to motivate students toward higher levels of performance was the daily charting of accuracy and time scores. The mean error scores of the total group have been similarly reported in Table 1. It may be noted that a leveling off occurred after the seventeenth or eighteenth administration of the BCR lists.

Table 1

Mean Error Scores for Successive Administrations of BCR Lists

N	Administration	Mean Error	N	Administration	Mean Error
24	1	26.46	19	16	2.42
24	2	18.67	19	17	1.63
24	3	14.46	19	18	2.21
24	4	13.25	19	19	2.63
24	5	12.00	19	20	1.79
24	6	9.21	14	21	2.21
24	7	7.79	14	22	2.28
24	8	6.62	14	23	2.28
24	9	7.54	14	24	1.78
24	10	5.38	14	25	2.14
23	11	4.74	14	26	2.14
23	12	4.13	14	27	.71
23	13	4.09	13	28	2.00
21	14	3.71	12	29	2.92
20	15	3.10	10	30	1.60

Speed of Recognition: The mean pre-experiment time score of the group was 11.21 minutes. The mean post-experiment time score was 5.98 minutes. A *t*-statistic for correlated observations using reciprocal time scores indicated a significant mean difference at the .01 level ($t = -8.79$, $df = 23$, $p < .01$). The reduction of mean time scores over subsequent administrations of the BCR lists are reported in Table 2. The mean recognition time for reading BCR lists decreased by 47%.

Table 2

Mean Time Scores for Successive Administrations of BCR Lists

Administration	Mean Time (seconds)	Administration	Mean Time (seconds)
1	770.67	16	285.26
2	661.62	17	292.37
3	585.00	18	286.05
4	510.71	19	283.52
5	483.00	20	287.42
6	496.96	21	288.57
7	460.88	22	264.00
8	469.96	23	247.14
9	446.71	24	252.71
10	445.33	25	241.93
11	425.87	26	239.28
12	408.18	27	244.14
13	403.78	28	235.54
14	356.86	29	232.67
15	329.00	30	231.30

It was anticipated that increased accuracy and speed of code recognitions would result in an increased braille reading rate. No loss of comprehension was expected. Since the background and braille experience of the students was quite varied the silent reading tests were not altogether appropriate for a few of the students. Consequently, the tests were not administered to some because of inappropriate grade level and/or inexperience with braille reading. As a result pre- and post-reading rates were obtained for only 20 of the students.

The pre-experiment silent reading rate was 64.38 wpm and the post-experiment rate was 73.58 wpm. A comparison of the means indicated a significant increase in braille reading speed ($t = 3.90$, $df = 19$, $p < .01$). The mean comprehension score for the pre-test was 12.1 and the posttest was 14.7. No loss of comprehension was noted, in fact a comparison of means indicated a significant gain ($t = 3.81$, $df = 19$, $p < .01$).

Discussion

The purposes of the project were fulfilled. Given a brief inservice experience a group of teachers were able to use the BCR materials effectively with a diverse population of braille reading students. The use of the materials by the students subsequently resulted in greater braille reading proficiency. The materials appeared to be effective with beginning braille readers as well as the most experienced students. Accuracy of braille code recognition and speed of recognition were again confirmed as observable indicators of increased braille reading efficiency. Parallel forms of a silent reading test given before and after training were used to demonstrate increased reading rates. The ultimate value of educational materials rests on their ability to change or improve student behavior in observable and desirable ways.

Information obtained from the teachers resulted in some minor adaptations of the materials. For greater convenience of use, the lines on the print copy of the BCR lists were numbered, and all word and letter meanings were noted on the print copy of the braille code exercises.

The instructional procedure was tutorial in nature and admittedly emphasized rote types of learning. Emphases to be placed on hand positions, posture, braille rules, and/or writing were left to the option of the teacher. In regard to motivation the approach introduced a competitive atmosphere in which the students competed against themselves to increase accuracy and speed of recognitions.

As noted in Table 1 the accuracy of recognition leveled off after the eighteenth administration of the lists. This suggests that the administration of 20 lists would be adequate for most students. Administrations beyond 20 would not necessarily produce increased accuracy scores.

Results indicated that the student was not able to improve both accuracy and speed of recognition at the same time and in this sense these indicators of improvement may be incompatible. When the goal was accuracy speed suffered and conversely when speed was emphasized accuracy was diminished. A logical approach would be to obtain a high degree of accuracy before emphasizing speed. The emphases may be communicated to the student by what score is currently being charted (i.e. accuracy score, time score). After just 10 administrations of the BCR lists the mean accuracy score of the group was approximately 97%. Subsequent administrations could very well focus on increasing the speed of recognitions. The user should also consider the materials as a means of brushing up on the code and as a way to maintain high levels of reading performance.

Based on prior studies, expectations regarding student performance were supported. Errors were decreased by 82% while Umsted (1970) reported decreases of 60%. Recognition time was reduced by 47% while

Umsted and Henderson (1967) reported reductions of 56% and 42% respectively.

The silent reading tests which were used to evaluate braille reading efficiency were questioned on grounds that they were inappropriate for a segment of the sample. For this reason, silent reading tests were not considered for inclusion in the package of BCR materials. The classroom teacher is in a better position to select appropriate diagnostic instruments for individual students.

CHAPTER ELEVEN

ADAPTATION OF EDUCATIONAL TESTS

The use of standardized tests for evaluating the scholastic attainment of students in the elementary grades through high school is a widespread practice. For example, Cronbach (1960, pp. 382-384) lists 10 separate batteries of achievement tests as examples of those available for this purpose. In 1918 Hayes (1918, pp. 42-54) reported to the American Association of Instructors of the Blind on the use of standardized tests for the seeing in the areas of reading, spelling, arithmetic, and language ability in three schools for the blind. Lowenfeld (1963, pp. 242-243) summarized attempts to use standardized achievement tests with the visually impaired in the United States since that early date. Among the tests he mentioned in use for the purpose can be found the Stanford Achievement Tests, Gray Oral Reading Check Lists, Metropolitan Achievement Tests, Sones-Harry High School Achievement Test, Myers-Ruch High School Progress Test, as well as tests offered for college entrance. More recently, Bauman (1974, chap. 5) reviewed the entire range of tests available for assessment of the blind and partially sighted. A comprehensive listing of references relating to testing of the blind has been compiled by Morris and Nolan (1971).

Many problems are encountered in adapting tests for the sighted for use by the visually handicapped. Among these are problems of methods of test administration, test time limits, test scoring, and test norms. These problems are discussed and solutions suggested in an analysis by Nolan (1962). The problems of test norms are particularly critical for braille editions of tests in which some items must be deleted because of lack of reproducibility in tactile form. Nolan and Davis (1967, pp. 86-92) describe two separate solutions to this problem as illustrated in the adaptation to braille of the 1964 edition of Form B of the Cooperative Sequential Tests of Educational Progress and Forms W and X of the 1963-64 edition of the Stanford Achievement Test. The methods used in the latter case, where the publisher's original normative data were rerun using only items to be found in the braille edition of the tests, is the most practical and was followed in this project where norms specific to the braille edition of tests were required.

Adaptation of available print tests is the most efficient and economical method of providing such measures for the visually handicapped. The effort and expense of identification of test specifications, item writing and review, item analysis, and test standardization are borne by the commercial developers and publishers. Additionally, development of original tests for use with the visually handicapped population is impractical because of the small number of subjects available for test refinement and standardization. As of 7 January 1974, there were only 25,809 legally blind students enrolled in other than college programs throughout the United States.

Task 1 Test advisory group meeting

Project Leader June Morris

Purpose

Due to the ever changing nature of educational programs, there is a continuing need for new tests and revised tests to be adapted for use by the visually handicapped. The reasons for convening a test advisory group were to obtain assistance in defining test needs, to learn of specific tests that would be both useful and appropriate for adaptation, and to establish priorities for the adaptation of tests.

Participants

The test advisory group was composed of four school psychologists from residential schools for the blind, three persons with testing interests from large public school systems with programs for the blind, and one private consulting psychologist who was experienced in working with visually handicapped students in both public and residential schools in several Eastern states. The participants were:

Mr. Don Adamchek, Psychologist, Ohio State School for the Blind, Columbus, Ohio

Mrs. Sarah Ashman, Certified Psychologist, Indiana School for the Blind, Indianapolis, Indiana

Mrs. Mary K. Bauman, Director, Personnel Research Center, Philadelphia, Pennsylvania

Mr. Carl Davis, Head, Department of Psychology and Guidance, Perkins School for the Blind, Watertown, Massachusetts

Miss Pat Hecht, Psychologist, previously with the Michigan School for the Blind, Lansing, Michigan

Mr. Kenneth Mayfield, Psychologist, St. Louis Special School District, Rock Hill, Missouri

Mrs. Mary Pinkelton, Supervisory Teacher for the Visually Handicapped, Cincinnati Public Schools, Cincinnati, Ohio

Mr. Jack Whitaker, Psychologist, Cincinnati Public Schools, Cincinnati, Ohio

Results

The test advisory group met at APH on 29-30 March 1973. The group agreed that there was need for a continuing effort to provide current educational measures for use with the visually handicapped. Test needs were identified and special recommendations were made for tests to be considered for possible adaptation and publication. These were as follows:

- Readiness Tests for Preschool and Primary Students
  - Boehm Test of Basic Concepts
  - Preschool Attainment Record
- Achievement Tests (General)
  - Wide Range Achievement Test
- Achievement Tests (Specific)
  - (1) Listening
    - Durrell Listening-Reading Series
  - (2) Mathematics
    - a diagnostic test of computational skills
  - (3) Reading
    - Durrell Listening-Reading Series
    - Gates-McGinitie Reading Tests
    - Hanley's braille code test
    - a diagnostic test of oral reading
  - (4) Vocabulary
    - Wide Range Vocabulary Test
- Mental Abilities Tests
  - Stanford-Kohs Blocks with norms extended downward
- Vocational Aptitude Tests
  - a test of mechanical and electronic comprehension
- Social Maturity Tests
  - Perkins Developmental Scale

The group recommended tests of general achievement and special achievement (reading and mathematics) be given immediate attention.

It should be noted that, at the time this meeting was held, adaptation of the 1973 Stanford Achievement Test Series, which included both the Stanford Achievement Test and its upward extension the Stanford Test of Academic Skills, was underway at APH. Subtests within this series provide for measurement of some of the specific areas of achievement for which test needs were identified. These tests will be discussed more fully in subsequent sections of this report.

In addition to defining test needs, the test advisory group identified some problems related to test use. One of these problems pertained to the need for providing norms for tests when administered orally. Another was that, because of the necessity of omitting many items from braille tests (e.g., those involving graphics that cannot be presented meaningfully in braille), braille editions of social studies tests do not generally measure as wide an array of skills as do their print counterparts. A third problem voiced by the advisory group was the need for tests to be updated more frequently.

In conclusion, the group requested APH to announce new or revised tests as they become available through the Association for Education of the Visually Handicapped's publication, the Fountainhead.

Task 2 Adaptation of the Stanford Achievement Tests, Forms A and B

Project Personnel June Morris

Purpose

The APH has been publishing tests for use by the blind for over half a century. As early as 1923, 18 tests were being published; each in New York Point, American Braille, and Revised Braille (grades 1 1/2). Although many early tests were embossed at APH, the responsibility of adapting the tests and providing the auxiliary materials required for their administration was left to others. It wasn't until 1957, with publication of the fourth Stanford Achievement Test series (Forms J, K, L, M, and N), that APH assumed responsibility for adapting tests and their directions as well as publishing them. It was at this same time and with this same test series that APH started publishing large type editions of tests.

APH has had a long history of publishing the Stanford Achievement Test. The first Stanford Achievement Test series was published in print in 1923. Since that time, new series have been released approximately every 10 years. Each series has been published in part or whole by APH for use by the visually impaired. When it became known that Harcourt Brace Jovanovich was in the process of developing a new series of their Stanford Achievement Test, contact was made with them regarding possible adaptation of the series for use by the visually handicapped. The stated reason why Harcourt Brace Jovanovich was bringing out a new series at this time was that their previous series (W, X, and Y [1964-65]) was rapidly becoming outdated primarily because of the tremendous changes occurring in elementary school curriculum (Harcourt Brace Jovanovich, 1973, p. 7). As curriculum for blind and sighted children is similar, this meant that APH too would need to provide an updated measure for achievement. Review of Forms A and B of the new Stanford Achievement Test indicated that it was one of the better achievement measures available and that, with the exception of its lowest level (Primary Level I for use with children in grades 1.5-2.4), it presented no insurmountable problems for adaptation. Two other factors weighted upon the decision to adapt this series. These were: (a) assurance of close cooperation by the publisher and (b) availability of the original norming data from which norms specific to those braille tests which varied from their print counterparts could be computed.

The need for new or updated achievement measures, both general and specific, was subsequently verified when the test advisory group met (Task 1). Although this group knew that Forms A and B of the Stanford Achievement Test were being adapted, they still went on record saying that achievement tests should be given top priority in APH's program of test adaptation.

Procedure

After selecting the test for adaptation, permission was obtained for the Stanford Achievement Test from its publisher, Harcourt Brace Jovanovich, in December 1972.

Two major tasks are required in adapting tests for the visually handicapped. First, the tests must be adapted and edited for both braille and large type reproduction, and second, the manuals accompanying the tests must be adapted and rewritten.

A number of processes were involved in preparing the Stanford Achievement Test for braille and large type reproduction. First, the 116 individual tests within Forms A and B of the series had to be critically reviewed to determine which tests and which items within tests were feasible for inclusion in the braille and large type editions. At this time it became apparent that the Primary Level I Battery would have to be omitted. The reasons for this were: (a) that many young visually handicapped children would not be able to perform adequately the necessary operations, (b) that most visually handicapped children at the grade levels for which this battery was designed are not able to read as well as their sighted peers and, consequently, would be at a disadvantage taking any standardized test requiring reading, and (c) because many of the tests in this battery are highly pictorial in content, it would not be possible to produce them in braille and, even if enlarged for a large type edition, would be of dubious legibility. During this review it also became apparent that Part A of the Reading Test, Social Science Test, and the Science Test of the Primary Level II Battery would have to be omitted from the braille edition because they too were highly pictorial in content. During this review, specific items from other tests for which braille reproduction would be impossible were also identified. Most of these items occurred in Social Science and Science tests and involved either maps or other forms of graphics that were too complex for tactual interpretation. A few such items were also found in the mathematics tests.

A list of items to be omitted from the braille tests was sent to Harcourt Brace Jovanovich with whom APH had contracted for recomputation of norms for all braille tests differing from their print counterparts. With this information, norms were computed on those items appearing in the braille edition using the same data from which the norms for the print edition were computed. As it was not necessary to omit any items from the large type edition, the regular norms are appropriate for use with these tests.

The next task in the adaptation of these tests was the editing of them for braille and large type reproduction. This included modifying the directions appearing in the test booklets and changing the format. With the braille tests the directions were changed to instruct students taking the Primary Level II tests to mark through their answer choices while for all other levels an answer sheet option was offered with students being instructed to either mark the letter by the answer of their choice in their test booklets or to mark the letter of their answer on their answer sheets. All answer choices, except in the Primary Level II tests, were edited to be preceded by letters a, b, c, d, and e, so that a standard answer sheet could be used with all. Items were renumbered in tests where items were omitted, and longer tests, in terms of administration time, were split into two parts so that the parts could be administered at separate sessions. The instructions and samples were repeated before each part where a test was split. As questions within tests were arranged to become progressively more difficult, test splits were made on an odd number even number basis so that the two parts would be of similar difficulty. Naturally, where sets of questions went together (e.g., three questions requiring the use of the same table) these were retained as sets. Each part in split tests was renumbered from one. The format used for the braille tests was that answer choices were listed vertically under the questions unless they were short enough to be contained on one braille line with no more than one answer choice extended over to a second line.

Editing for large type reproduction was not as extensive as for braille reproduction. The directions were modified to instruct students to mark the letter or number by the answer of their choice, rather than to mark circles off to the side or below the answer choices as called for in the print edition, or, in the case of the Primary Level II tests, to instruct students to mark through the answer of their choice. No answer sheet option was offered with the large type edition of the tests as the consensus of psychologists queried on this matter was that partially sighted students who use large type would not be able to use answer sheets with enough facility to warrant such an option being offered. It was not necessary to split any of the tests in the large type edition nor omit any items.

Prior to adapting the directions for administering the tests, the question of time limits had to be resolved. As these tests are power tests rather than speed tests, both the test publisher and the test advisory group recommended that the adapted test be administered without time limits. However, the latter acknowledged that time limits would have to be suggested for use in situations where it was absolutely necessary to impose them. Therefore, such time limits were computed expanding the administration time by the same 2.5:1 and 1.5:1 ratios for braille and large type, respectively, used with the two preceding Stanford Achievement Test series. Using these times as a basis, proposed testing schedules were worked out for the administration of all tests within a battery keeping the total time for individual test sessions similar to those proposed for administration of the print edition at the same level. Because of the greater amount of time required, more sessions are required for administration of the braille edition of the Stanford Achievement Test than for the print edition. Rest periods are included with all longer testing sessions.

The final task in adapting the Stanford Achievement Test for use by the blind was to revamp the manuals accompanying the tests. Ten such manuals were involved; one each for the braille and large type editions for each of the five levels of the Stanford Achievement Test being adapted. These manuals include sections on general directions for administering that are specific to the visually handicapped, the previously mentioned proposed schedule for administering, detailed instructions for administering, directions for scoring, lists of correct responses, and, for those braille tests in the Stanford Achievement batteries differing from their print counterparts, norms and accompanying statistical data. For all other tests, those from which it was not necessary to omit items, the norms and statistical data published by Harcourt Brace Jovanovich are appropriate for use with the adapted tests. Two options of administration, as suggested by the test advisory group, are offered in the detailed directions for administering. First, specific directions are given for administering the tests either with or without time limits, with the latter always being given preference by being presented first; and second, an option is offered for administration of the longer braille tests, those split and others, in either one or two test sessions. This was done to accomodate for the wide disparity in rate at which braille students work. Often these tests are administered individually and, with this option, an entire longer test can be given to a student who works rapidly within a single test session of reasonable length. These options are offered in order to provide maximum flexibility in test administration so that the procedure most appropriate for an individual situation can be selected for use.

Once the manuals containing the directions for administering, etc. were adapted and rewritten, drafts were submitted to Harcourt Brace Jovanovich. These drafts were reviewed by their test editors and approval was granted in January 1974 for publication of the manuals.

As the format and instructions for taking Forms A and B of the new edition of the Stanford Achievement Test are quite similar to a number of tests (Forms W and X of the Stanford Achievement Test; Form A of the Cooperative School and College Ability Test; and Form B of the Cooperative Sequential Tests of Educational Progress) available in both braille and large type and in common use, it was not deemed necessary to try out the tests, the instructions for taking the tests, nor the directions for administering the tests prior to their publication.

Materials description

The 1973 Stanford Achievement Test holds promise of being the most useful to date. The test content and range have been expanded and the items meticulously selected to accurately reflect what is actually being taught in schools today (Harcourt Brace Jovanovich, 1973, p. 7). A full description of the test development and standardization is provided by its publisher (Harcourt Brace Jovanovich, 1973, pp. 7-10). The test is composed of the following test batteries:

*Primary Level I	Grades 1.5-2.4
Primary Level II	Grades 2.5-3.4
Primary Level III	Grades 3.5-4.4
Intermediate Level I	Grades 4.5-5.4
Intermediate Level II	Grades 5.5-6.9
Advanced	Grades 7.0-9.5

Two forms of the test, Forms A and B, are complete for each level while a third form, Form C*, designed for use in special large programs, contains only reading and mathematics tests.

With only three exceptions, the tests included in the print and large type editions of the Primary Level II Battery through the Advanced Battery are: Vocabulary, Reading Comprehension (or Reading), Word Study Skills, Mathematics Concepts, Mathematics Computation, Mathematics Application, Spelling, Language, Social Science, Science, and Listening Comprehension. The three exceptions are that the Language Test is omitted from the Primary Level II Battery and the Word Study Skills and Listening Comprehension tests are not included in the Advanced Battery. The braille edition contains the same tests as do the print and large type editions except for the previously mentioned tests that had to be omitted from the Primary Level II Battery; namely, Part A of the Reading Test, the Social Science Test, and the Science Test. The tests within the large type batteries are contained, generally, in two pamphlets while those within the braille batteries are contained in up to four pamphlets.

Norms for the Stanford Achievement Test are in the form of grade equivalents, scaled scores, percentile ranks, and stanines.

Braille and large type editions of Forms A and B of the Stanford Achievement Test will be available for use during the 1975-76 school year from APH. In order to be able to administer these tests and interpret the results, it will be necessary for the examiner to use the appropriate Directions for Administering (Braille) (Large Type) Edition, the appropriate Norms Booklet, and the appropriate Teachers Guide. Ten sets of Directions for Administering are available as these are separate for different levels of the test and for different editions of the test (braille or large type). Each of these, however, can be used with each form of the test. Norms Booklets are available for each form and level of the test. Teachers Guides are available for each level of the test. All may be obtained from APH. The Norms Booklets and Teachers Guides may also be purchased from Harcourt Brace Jovanovich along with Administrators Guides and Class Record Forms either complete or separate.

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* Not to be produced in braille or large type

Results and concluding statement

Provision of Forms A and B of the newest edition of the Stanford Achievement Test in braille and large type will partially meet the test advisory group's strongly voiced need for up-to-date achievement measures. The individual tests within the test batteries can be used to measure specific areas of achievement while the complete test batteries provide for an overall measure of general achievement.

Task 3 Adaptation of the Stanford Test of Academic Skills (TASK)

Project Personnel June Morris

Purpose

TASK is a new test. It was first released in 1973-74 by Harcourt Brace Jovanovich as an upward extension of their Stanford Achievement Test. Together, the two tests comprise the 1973 Stanford Achievement Test Series. Adaptation for braille and large type reproduction and administration for the two tests was done simultaneously and similarly. As the two tests were done together, most of what was written regarding adaptation of the Stanford Achievement Test applies equally to TASK. Therefore, it will only be recapitulated here.

TASK is for use with grades 9 through 12 and, as such, will extend the range over which current achievement measures are available for use with the visually handicapped. Although TASK was in the process of being adapted at the time the test advisory group met (Task 1), its adaptation will help satisfy the top priority need identified by this group; namely, the need for up-to-date achievement measures.

Procedure

Initial review of TASK indicated no serious problems would be encountered in adapting it for use by the visually handicapped. Permission to adapt Forms A and B for braille and large type reproduction was obtained from the publisher in December 1972.

The editing of TASK primarily involved changing its format. The print edition was set up for responses to be recorded on answer sheets. Copy for the braille edition was edited to reflect the standard format for braille tests which offers an option permitting answer choices to be marked either directly on the test booklet or on a separate answer sheet. Copy for the large type edition was edited to a format appropriate for answers to be marked directly on the test booklet with no answer sheet option offered. Test instructions were changed accordingly for both editions.

It was not necessary to omit any items from either the braille or large type editions of TASK; therefore, the norms provided by the test publisher for use with the print edition are appropriate for use with the braille and large type editions as well.

None of the tests within the TASK batteries were divided or split because of excessive length. Although the tests are fairly long, a decision was made against splitting them as they are for use by students in grades 9 through 12 who would be roughly 14 through 18 years of age. It was felt that persons at this age level should be able to work for fairly long periods without becoming unduly fatigued.

TASK is a power test as is the Stanford Achievement Test; therefore, for the same reasons as for the Stanford Achievement Test, it is recommended that TASK be administered with no time limits. However, as an administrative convenience for use when absolutely necessary, time limits were computed and are suggested. These were computed from the now standard ratios of 2.5:1 for braille to print and 1.5:1 for large type to print. Maximum time for any one test session computed from these is approximately 115 minutes for the braille edition and approximately 65 minutes for the large type edition. A rest period is included in the maximum time reported for the braille edition. A complete TASK battery of either edition can be given in three test sessions.

Adaptation of the manuals containing the directions for administering TASK was similar to, though not as extensive as, that reported for the Stanford Achievement Test. Only two manuals are required for administration of TASK to the visually handicapped; one for the braille edition and one for the large type edition. The manuals include the following sections: Teacher's General Directions for Administering which includes a proposed schedule for test administration, Teacher's Detailed Instructions for Administering, Directions for Scoring, and Lists of Correct Responses.

When the manuals were adapted and rewritten, they were submitted to Harcourt Brace Jovanovich for approval. There, they were reviewed by members of the Test Department's Editorial Staff and subsequently approved for publication.

No field testing was done on the adapted tests within the TASK batteries, the students' instructions, nor the teachers' instructions as all were adapted in the customary manner.

Materials description

Two levels and two forms of TASK have been adapted for the visually handicapped and will be available in braille and large type during the 1975-76 school year. Level I is for use with students in grades 9 and 10 and Level II is for use with students in grades 11 and 12. The two forms, A and B, are parallel. Each test battery contains three tests: Reading, English, and Mathematics. In the braille edition each test is in a separate booklet. However, with the large type edition each test battery is contained within one test booklet.

Harcourt Brace Jovanovich also advertises an abbreviated Form C of the test and a college edition of Level II. Neither of these has been adapted for use by the visually handicapped.

Norms for TASK are in the form of grade equivalents, scaled scores, percentile ranks, and stanines.

The Directions for Administering (Braille)(Large Type) Edition of TASK and the auxiliary material needed for interpreting the test results will be available from APH. However, Administrators Guides and Class Record Forms will have to be obtained from Harcourt Brace Jovanovich.

Results and concluding statement

Adaptation of Forms A and B of TASK to braille and large type expands the range for which current achievement measures are available for use with the visually handicapped. The Stanford Achievement Test can be used for grades 2.5-9.5. TASK provides a tool for the measurement of achievement in grades 9-12. Thus, the two tests comprising the 1973 Stanford Achievement Test Series neatly complement one another. As with the Stanford Achievement Test, TASK will be available in braille and large type during the 1975-76 school year. Together the two tests help fill the need, so strongly stated by the test advisory group, for up-to-date achievement measures.

Task 4 Adaptation of the Wide Range Achievement Test (WRAT)

Project Personnel June Morris

Purpose

The WRAT is a short test designed to measure level of skill in oral reading, spelling, and arithmetic computation. The test's authors are J. F. and S. R. Jastak. WRAT is published by Guidance Associates of Delaware, Inc., and is distributed by The Psychological Corporation, Inc.

When the test advisory group met at APH (Task 1), it specifically requested that this test be adapted for use by the visually handicapped. One of the features of the test making it of particular value is that it can be used to diagnose disability in reading, spelling, and arithmetic.

Procedure

After selecting a test for possible adaptation for use by the blind, the first step is always to obtain permission to reproduce it in braille and large type. Such permission was requested for the 1965 edition of WRAT and was granted in December 1973.

There are two levels of the three tests (reading, spelling, and arithmetic) comprising WRAT. Additionally, there are pretests for each of the three for use with young children and older persons who perform poorly. Review of the test indicated that all parts and items, except for the prespelling part, could be transliterated into braille without difficulty and that all parts could be reproduced in large type. However, the review also indicated that the format for both the braille and large type editions would have to be altered.

The braille edition of WRAT, unlike the print and large type editions, will be reusable as the testee will not record his responses on the test booklet. He will, rather, write his responses to the tests (i.e., words to be spelled and answers to arithmetic problems) in braille on braille paper or respond orally to the test questions. The editing of WRAT for braille included omitting the prespelling test as this test required the drawing of symbols, a task that is not appropriate for persons without sight; distinctly separating Levels I and II of the reading and arithmetic tests; setting up the arithmetic tests in standard braille format; and changing the format of the prereading and prearithmetic tests.

Editing copy for the large type edition of WRAT included two main steps. These were to distinctly separate Levels I and II of the reading and arithmetic tests and to change the format of the arithmetic tests to provide for better legibility. The tests will be produced in 18-point type. As with the print edition, the testee using the large type edition of WRAT will write his answers to the spelling and arithmetic tests directly in the test booklet.

After the tests were edited, the directions for administering them had to be altered accordingly. Separate sets of directions were prepared for the braille and large type editions. In both cases time limits were dropped so that both are to be administered without time limits.

The directions for administering the braille edition required more extensive revision than those for the large type edition. This was because of the change in mode of response as well as in format. In all instances, responses to the reading tests are oral; however, in the braille edition an option is offered allowing responses to the spelling and arithmetic tests to be in either oral or written form. Naturally, when oral, the tests must be administered individually.

Included with the directions for administering the braille edition of WRAT is scoring information. This presents lists of correct responses for the spelling and arithmetic tests which not only show the correct answer in print, but also show how the answers should appear when written in braille. For the spelling tests this latter is in the form of grade one braille (fully spelled) and for the arithmetic tests it is in the form of the Nemeth Braille Code for Mathematics and Science Notation, 1972 Revision.

It was not necessary to delete any items from within any of the WRAT tests when adapting them for braille and large type. Consequently, the norms provided by the publisher for use with the print edition are equally appropriate for use with the braille and large type editions. Because the prespelling test could not be included with the braille edition of the test, the lower age range or achievement level over which spelling can be measured by the braille edition of WRAT is somewhat restricted. Normally, the prespelling test is given to all children under 8 years of age. Therefore, unless a braille student below this age is an unusually good speller, it will not be possible to measure the level of his performance using WRAT. Likewise, with older persons who are poor spellers, it may not be possible to use this test to determine the exact level of performance.

Both the braille and large type editions of WRAT could be adapted using formats common to braille and large type tests and textbooks. As no unique methods of administration or techniques for responding were called for, it was not deemed necessary to field test these materials.

Materials description

There are two levels of WRAT. Level I is for use with children 5 years 0 months of age through 11 years 11 months. Level II is for use with persons 12 years 0 months old through adulthood. Within each level of WRAT there are three subtests: reading, spelling, and arithmetic. The reading test is an oral test requiring the recognition and naming of letters and the pronunciation of words. The spelling test requires that single words be spelled to dictation. The arithmetic test involves counting, reading numbers, solving oral problems, and computing answers to written problems. Although the braille and large type editions of the tests are to be administered without time limits, administration time for the individual subtests should not run over 45 minutes and 30 minutes, respectively, for the two.

Norms for WRAT are in terms of grade ratings, standard scores, and percentiles.

All materials required for administering, scoring, and interpreting scores for the braille and large type editions of WRAT will be available from APH. For the braille edition these include a copy of the reusable braille test, which will be contained in one booklet; a copy of the print test; the WRAT Manual; and the Supplemental Directions for Administering and Scoring the Braille Edition of the Wide Range Achievement Test. For the large type edition these will include the large type test, which will be contained in one booklet; a copy of the print test; a print copy of the reading test for use by the examiner in recording responses to the reading test; the WRAT Manual; and either supplemental directions for administering the large type edition or the WRAT Manual edited to show same.

Results and concluding statement

Copy for the braille and large type editions of WRAT, along with their accompanying directions for administration, was completed and turned over to the Editorial Department of APH. Publication should occur during Fiscal 1976.

The addition of this widely used test to those available for use with the visually handicapped will be a valuable asset to psychologists working with this population. It can be used both for obtaining quick estimate of an individual's general level of ability and educational background and as a clinical tool for psychologists working with specialized cases.

Task 5 Adaptation of the Wide Range Vocabulary Test (WRVT)

Project Personnel June Morris

Purpose

The WRVT is an old test, the original Form A dating back to the early 1900's, that has remained popular through the years as a preliminary screening tool for measurement of the verbal factor to determine the scholastic intelligence of literate individuals. Forms B and C of the test are published and distributed by The Psychological Corporation.

At the time the test advisory group met to consider test needs (Task 1), it specifically requested that this test be adapted for use by the visually handicapped. Consequently, such adaptation was undertaken.

Procedure

Review of the WRVT indicated there would be no problems in adapting it for braille and large type reproduction. Permission to do so was granted by its publisher in February 1974.

The editing of WRVT for braille and large type reproduction presented no difficulties as it is a multiple-choice type test for which appropriate braille and large type formats are clearly defined. All items are of a verbal nature so none had to be omitted; therefore, the norms provided for use with the print edition are also appropriate for use with the braille and large type editions.

The instructions for administering the braille edition of the test were adapted to reflect the format used in the braille test and to provide additional information regarding the scoring of the test. This latter included an explanation of the braille numbering system and indication of the position of all correct responses shown on the scoring keys making possible scoring by a person with little knowledge of braille.

The instructions for administering the large type edition of the test were altered to reflect the format used in this edition. No other changes were necessary.

When a test can be adapted to braille and large type in a format common to tests produced in these media and when there is nothing unusual required of the testee while taking the test, then there is no need for the test to be tried out or field tested prior to its publication in braille and large type. Such was the case with WRVT.

Materials description

There are two equivalent forms of WRVT currently in use. These are Form B, first published in 1937, and Form C, which bears a 1945 copyright date. Each form contains 100 multiple-choice questions. WRVT is for use with persons from grade three through adulthood. Norms for the test simply report median scores for ages 8-21 which can be translated to median scores for grades three through the fourth year of college. All editions of the test are untimed; however, approximately 10 minutes, 25 minutes, and 15 minutes are required to administer the print, braille, and large type editions, respectively,

All materials required for administering the braille and large type editions will be available from APH. Auxiliary materials for use with the braille edition include the Manual and Key, a copy of the print test, and a copy of the Special Directions for Administering the Braille Edition. The auxiliary materials needed to administer the large type edition include the Manual and Key and a copy of the Special Directions for Administering the Large Type Edition.

Results and concluding statement

Copy for Forms B and C of WRVT, prepared for braille and large type reproduction, was turned over to the Editorial Department of APH. At the same time copy for the Special Directions for Administering the (Braille) (Large Type) Edition of the test were completed and submitted. Publication should occur during Fiscal 1976.

Adaptation of this test for use with and by the visually handicapped not only adds to the number of instruments available for use in evaluating the blind, but provides a different type of tool; namely, one that can be administered quickly and used to get a rough estimate of verbal intelligence. It was the opinion of the test advisory group that this test, when available, would be widely used.

CHAPTER TWELVE

OTHER MATERIAL DEVELOPMENT

During the course of the IMRC program, several projects were undertaken which lacked the more programmatic form of the projects described in previous chapters. There were ten such projects in all. Most of the projects concerned topics that were of timely interest.

Three studies concerned low visioned students; two of these dealing with reading media and the third with visual discrimination training materials. Three additional projects concerned the use of braille; two dealing with devices for braille writing and the third with braille paper preferences of students.

Two projects represented a late attempt to initiate a program to develop materials for training teachers. A survey of teacher training needs was followed by development of a program to teach teachers to use the abacus.

Two final studies involved improvement of an already available material, the Chang Mobility Kit, and adaptation for production of a recorded typing curriculum developed elsewhere under federal support.

Task 1 Evaluation of seated parquetry formboards for students with low vision

Project Personnel Roy Brothers and Amie Dennison

Purpose

Over the years parquetry has been given a place in both the educational and recreational activities of children. Parquetry, as represented by blocks of different size, shape, and color, has afforded children with many opportunities to compare, sequence, and discriminate among its parts, and the challenge inherent in reproducing or creating designs has certainly contributed to the appeal of parquetry as a leisure time activity.

Many versions of parquetry have been commercially produced, but for the most part they have been designed for the child with normal vision. In 1969, the APH IMRC initiated a project to develop parquetry materials for the low vision student. It had been noted that when very low vision students used regular forms of parquetry, parts were easily moved out of position or temporarily misplaced. It was often the result of some random movement of a hand or arm. Some adaptations were apparently needed to structure or control the workspace.

As a result of this need for a controlled workspace, special formboards were developed to seat the regular parquetry blocks. The student could then manipulate the total workspace, hopefully avoiding undue fatigue of frustration.

It was anticipated that the materials as adapted would provide the low vision student with many opportunities to look long and closely at the stimulus materials, and additionally that the nature of the task would be attractive to the students.

The purpose of the study was to determine the feasibility of developing formboards and stimulus materials to accompany parquetry blocks. The investigation was concerned with three general areas. These were:

(1) to determine those visually handicapped students for whom the materials would be most meaningful.

(2) to determine the effectiveness of the materials in meeting special visual needs of the students as well as the educational objectives appropriate to their level of development.

(3) to determine the appeal of the materials or the degree to which formboards were accepted by the students and by the teachers.

Procedure

Materials were developed and placed in the field. As part of the field test, students from grades 1 through 12 were observed using the materials as they performed a series of prescribed tasks. Grades 1 through

3 were designated as Primary level; grades 4 through 6, Intermediate level; and grades 7 through 12, Advanced level. Instructions to the teacher-observers attempted to provide a common frame of reference regarding the purposes of the study. In order that the required observations be as consistent as possible, the observers were encouraged to become thoroughly familiar with the purpose of the study, the administration of experimental conditions, and with the two questionnaire forms designed to focus upon the observation period.

Questionnaires: The first questionnaire was related to the individual student and was designated the Student Record Form (SRF). The SRF itself was divided into two parts. Part 1 was related to the general background of the student: his grade level, IQ, mode of reading, level of academic functioning, and prior experiences with the more basic elements of parquetry such as the shape and color of blocks. Part 2 of the SRF was completed during the observation period and emphasized the student's performance: his use of near vision, manipulative approach, and preferences for certain designs.

The second questionnaire was called the Teacher Observer Form (TOF) and was completed after all observations had been made. In addition to serving as the vehicle for organizing their general impressions of the materials, it also provided respondents with an opportunity to make specific recommendations for adaptations or changes.

As mentioned earlier, conditions for the try-out phase or field test were standardized as much as possible. The order of presentation for the stimulus designs was specified, and when the student was offered a choice of designs, the SRF specifically requested the order of his preferences. Introduction of the formboard occurred at a common point in the presentation, and many opportunities were present for recording student comment. In conducting the observation, teachers were instructed to provide a free or unstructured time period and to use that time for further observations of the student. The purpose of the unstructured time was to determine individual preferences for specific materials or their manipulation.

Since the target population was yet to be determined, the group of students utilized in the field test tended to be heterogeneous.

Subjects

Although a total of 231 students were observed, complete background information was not made available for each student. As a result, in some of the descriptive categories the total number of students does not equal 231. Table 1 describes the subject population by grade level according to mode of reading, and prior experience with parquetry.

A total of 31 teachers observed the 231 students who attempted the prescribed series of parquetry tasks. The teachers and their students represented three public and four residential school programs. The states represented through participating schools were: Arkansas, Florida, Kentucky, Maryland, North Carolina, Oregon, and Tennessee.

Table 1

Principal Mode of Reading and Prior Experience with Parquetry as Reported by Teachers-Observers

		Mode of Reading			Prior Experience		
N	Grade Level	Regular Type	Large Type	Braille	None	Limited	Extensive
96	Primary	13	63	11	73	21	0
60	Intermediate	15	37	6	30	27	2
71	Advanced	20	34	12	49	19	2
4	Special	1	2	1	2	1	0
231		49	136	30	154	68	4

Results

One assumption underlying the use of parquetry has been that it provides the child with an opportunity to learn basic discriminations of shapes and colors. However, data based on 229 cases revealed that 166 of the Ss were already familiar with the shapes being used. Table 2 describes by grade level the 63 Ss who were unfamiliar with one or more of the shapes being used.

Table 2

The Frequency that Shapes were Reported as Being Unfamiliar to the Student

Reported Shapes	Grade Level				
	Primary	Intermediate	Advanced	Special	Total
Square - Diamond Triangle	7	0	1	0	8
Square - Diamond	1	0	0	0	1
Triangle - Diamond	6	0	2	0	8
Square	0	0	1	0	1
Triangle	0	1	1	0	2
Diamond	24	11	4	4	43
Total	38	12	9	4	63

Parquetry activities having shape discrimination as a major objective would appear more appropriate for the primary level student. Based on the present sample, slightly less than half of the primary group were unfamiliar with one or more of the shapes being introduced. The use of these materials to learn color discriminations would seem less fruitful. Two hundred twenty-two Ss were reported as having had experience with the primary and secondary colors used, with only six reporting any unfamiliarity.

A basic educational goal, especially important to the visually handicapped child, is that of independence. A basic question of the study was concerned with the materials' contribution toward independent study activity.

One aspect of the question relates to the challenging nature of the materials and their general appeal for the student. Suggested parquetry activities which emphasized more complex tasks were provided to each teacher, however the observation or evaluative phase of the study was limited to rather fundamental parquetry tasks. Apparently the students quickly understood the task that was presented to them. In the opinion of the observers 87% of the students understood the task after one trial, and the percentage reached 96% after two trials. When asked to seat the blocks in the formboard 87% understood the task after one trial and 94% understood after two trials. Table 3 provides further descriptive data concerning the Ss ability to understand the task.

Table 3

Number of Designs Presented Before Student Understood the Nature of the Task

	Designs Presented				
	0	1	2	3	4
Under Control Condition (i.e., without formboard)	11	173	19	7	2
Under Experimental Condition (i.e., with formboard)	17	170	14	11	3

The apparent ease with which most Ss learned the task suggests that the activity could be carried out with a minimum of adult supervision. In fact, 70% of the teacher-observers felt the parquetry formboard contributed to the students' independent work skills. For the reasons stated the activity should have considerable appeal for many teachers.

Observers were also asked to make a judgment concerning the degree to which the manipulative task was eased as a result of using the formboard. The date seemed to indicate the judgments were related to the students' level of visual functioning. In support of this notion Table 4 lists the percentage of the students in each vision category and the degree to which the formboard aided them.

Table 4

Contribution of the Formboard in Easing the Manipulative Task

	Degree of Contribution		
Vision Category	No Contribution	Limited Contribution	Great Contribution
Ss functioning at 1-4" (N=65)	11%	32%	57%
Ss functioning at 5-10" (N=113)	18%	42%	40%
Ss functioning at 10" or more (N=45)	29%	29%	42%

It is interesting to note that although the formboard was designed to be manipulated (i.e., picked up and still hold its blocks securely), the majority of students did not choose to take this option. Also it should be noted that students were specifically told that it was permissible to pick up either the card and/or the formboard in order to examine the working area more effectively. When the observed responses were analyzed beyond that of a majority response, it became apparent that those at the lowest functional levels did indeed make greater use of the pick-up option.

The final phase of the investigation dealt with the appeal of the materials for the child. He was familiarized with the task and given several opportunities to work with the formboards and without them. Judgments concerning the materials' appeal have been based on the observed behaviors of the student when he was given free time to manipulate the materials. Given an opportunity to use or not to use the formboards students chose to use them in the majority of cases. One hundred forty-eight Ss or 65% of the sample chose to work with the formboard when given free time and an option to use or not use the experimental materials. When the data were classified by student characteristics, it was observed that certain groups were more likely to use the material and apparently to have greater need for it. Table 5 tends to identify the target population for the future development of such materials.

Table 5

Percent of Students by Category Who Chose Control or Experimental Condition

Choice of Condition	Level of IQ (N=215)			
	Below 85	85-115	Above 115	Total
Control	6%	22%	5%	33%
Experimental	25%	40%	2%	67%
	Mode of Reading (N=221)			
	Braille	Large Type	Regular Type	Total
Control	5%	20%	9%	34%
Experimental	9%	42%	15%	66%
	Visual Efficiency (N=223)			
	1-4"	5-10"	Over 10"	Total
Control	8%	20%	8%	36%
Experimental	21%	30%	13%	64%
	Grade Level (N=223)			
	Primary	Intermediate	Advanced	Total
Control	13%	8%	14%	35%
Experimental	30%	19%	16%	65%

One question asked the contribution of the formboard toward the creative effort of the students. Responses were mixed, 8 observers felt creative effort was enhanced, and 7 felt it was hampered. The remaining 13 observers had no comment.

Students of average IQ and below elected to work with the formboard more often than the high IQ group. It seems that the stimulus diagrams may not have offered a sufficient challenge for this group. However, activities have been suggested that can increase difficulty appreciably.

Students who read large type or braille and held their work within 10" were more apt to select the formboard for their parquetry activity. It also seems apparent that the materials would be most appropriate for grades 1 through 6.

Discussion

The feasibility of producing adapted parquetry materials for visually handicapped children depends in some part on the market potential for such materials. The teachers who had observed their students using the materials were asked if they would purchase them if they were available. Of the 29 observers who responded to this question, 14 answered yes and 15 responded no. Since the primary and intermediate levels seem to be the more appropriate target populations, a breakdown was made of the teachers who observed these particular students. The majority of those who observed elementary and intermediate grade students apparently did see a potential benefit from working with these types of materials. While some of the teachers would buy the materials "as is" their responses to specific questions and their comments would indicate that some changes would be highly desirable. Anticipating that some revisions would be made, a series of questions dealt with establishing some guidelines for future development of parquetry design and the sequential arrangement of tasks.

Teachers were asked, "Which of the following appeared to contribute to the difficulty of the task?" Twenty-eight responded to one or more of the following descriptions: colors used 11, shapes used 11, number of blocks 5, size of blocks 3, design used 14, and failure of the blocks to fit properly 19. The development of future materials must certainly insure that all pieces fit properly. Secondly, it appears that manipulations of the design requiring different shapes and colors can be used to approximate levels of difficulty.

The question of durability did not seem to be a factor in any preferences expressed by the teachers. Twenty-five said the materials were sufficiently durable while only three reported any deficiency. Of the three, two reported chipping and one fading of colors.

Other comments of the teacher-observers will be used in further development of the materials. The frequency with which suggestions appeared were tabulated. Results appear in Table 6.

Table 6

Frequency of Suggestions for Adapting Materials

Suggestion	Frequency
fewer blocks	10
greater variety of shapes	8
fewer colors	6
greater variety of color	2
more blocks	2

Summary

The field test was conducted using a relatively large and diverse population of students. Although the evaluation was dependent upon the judgment of individual teachers, the responses received indicated a high degree of interest and cooperation.

Purposes of the study were achieved. The materials were more readily accepted by students having lesser amounts of vision, and the formboards were duly noted as easing the manipulative task of the student. Level of IQ may have been a factor, but the large proportion of students tested readily used the materials in their field test form. Several suggestions have focused upon ways of making the designs more challenging which should aid in interesting students of any intellectual level.

The target population was also identified as being within the elementary grades. The activity was felt to contribute to the development of independent work habits and of primary importance it required students to actively use their vision for periods of 20 to 30 minutes. A description of attending behavior was not specifically requested, but no comments were forthcoming concerning the materials inability to hold the childs attention for the required trial period of approximately 30 minutes.

The materials were subsequently produced and distributed by APH. They are pictured and described in a brochure included in Appendix B.

Task 2 Microfiche as a large type medium

Project Personnel Carson Nolan and Nancy Steele

Purpose

In January 1974, 45% of legally blind children in the United States were registered as large type readers with the American Printing House for the Blind. In addition, many more students who have lesser visual handicaps also read large type. While it is economically feasible to print the most frequently used textbooks in large type, it is not feasible to supply demands for small numbers of any text (less than 50) at a reasonable cost.

Reproduction of textbooks in microfiche form appears a possible way to provide large type texts in small numbers. Reproduction of 5-10 copies at a time results in costs comparable to those resulting from reprinting books in large type in quantities of 100-200. The cost of the microfiche viewer, which often requires special lenses, is in addition to this. The lack of portability of viewers and their space requirements may cause some problems in use of this medium. However, the advantages of supplying small quantities of texts at a reasonable cost may offset these.

The purpose of the study reported here was to explore the ability of visually handicapped students to read text material displayed on microfiche viewers in large type form. Reading of the microfiche display was compared to that for regular print and large type.

Procedure

The necessary materials for the study including the microfiche viewer were taken to the various locations in Louisville, Kentucky where subjects attended school. Each subject was administered the reading tasks individually. An informal introduction to the task was presented to the subjects by the examiner who explained that they were participating in a study to determine what kind of printed material was most helpful to students' reading. At this time, the subjects were also asked which size type they most often used for reading, regular type or large type.

Each subject was presented the three short passages of a story at the grade level most appropriate to his reported reading level. The subjects were asked to read each passage orally in either regular size print, large type, or on the microfiche viewer. The order in which the three passages was presented was randomly determined as was the mode in which each passage was to be read. As the subject read, the examiner followed a copy of the passage and marked oral reading errors by the system devised by Gray (1955). The five general categories of oral reading errors are listed below.

Words mispronounced
Syllables mispronounced
Insertions
Omissions
Repetitions
Substitutions

The length of time required to read each passage was also recorded.

Subjects

Subjects were 46 visually handicapped large type readers whose visual acuity did not exceed 20/70 in the better eye after correction. Twenty-nine subjects attended the public school classes for partially seeing students in Louisville, Kentucky. Seven of these students were legally blind with vision below 20/200 in the better corrected eye. Seventeen subjects who were legally blind attended the Kentucky School for the Blind. All students read at approximately the fourth grade level or better. The sample included students in elementary, junior, and senior high school. The distribution of students by grade groups is shown in Table 1.

Table 1

Distribution of Ss by Grade Level

	Elementary	% of n	Jr. High	% of n	Sr. High	% of n	Total n
Public Day School	6	21%	13	44%	10	35%	29
Residential School	3	18%	9	53%	5	30%	17
Total	9	20%	22	47%	15	33%	N=46

Materials

Three reading selections of approximately the same length were chosen from each of three text books representing the fifth, seventh, and eleventh grade levels. Reading difficulty was determined for each by methods described by Flesch (1951) to equate passage difficulty within each grade level. Information relative to these passages and their sources are given below.

McCracken, G., & Walcutt, C. C. Basic Reading (5). New York: Lippincott, 1965.

"Freddy Applegate Hunts Treasure"

BR 1	246 words	easy-fairly easy
BR 2	241 words	fairly easy
BR 3	242 words	fairly easy

Jewett, A., Edman, M., & McKee, P. Adventure Bound (7). Boston: Houghton Mifflin, 1956.

Unit 1, "Animals"

AB 1	296 words	easy
AB 2	294 words	easy
AB 3	309 words	easy

Pooley, R. C., (Ed.) The United States in Literature (11). Chicago: Scott Foresman & Co., 1963.

"The Sculptor's Funeral"

USL 1	300 words	fairly easy

"Paul Revere and the Alarm"

USL 2	289 words	fairly easy
USL 3	299 words	fairly easy

Each of the three passages from each level was made available in three forms. The regular ink-print edition was produced and made available by the respective publishers. The large type edition was reproduced by APH. The particular passages used in the study were also reproduced in microfiche by the IBM Corporation.

The microfiche were reproduced on a card 7 5/16 x 3 1/4 inches containing 60 frames. Negative images were displayed in approximately 18 point size on the screen (14 x 15 inches) of an IBM 9921 Document Viewer fitted with a 38X lens.

Results

Grade Level: Table 2 presents the number of students in each program who used materials at the various reading levels as recommended by their teachers.

Table 2

Distribution of Ss According to Level of Material Read

School	Elementary		Jr. High		Sr. High		Total
	BR	% of n	AB	% of n	USL	% of n	Total
Public School	n = 16	55%	n = 13	45%	n = 0	---	29
Residential School	n = 9	53%	n = 3	18%	n = 5	29%	17
TOTAL	n = 25	54%	n = 16	35%	n = 5	11%	46

The proportion of the sample for each program and the total number of Ss is also presented in this table. It is interesting to compare these findings with those presented in Table 1, which presents the proportion of students included in the study at the various grade levels. Better than half of the Ss in both programs were reading at an elementary level. None of the Ss in the public school program read at a high school level. Only a small proportion of those in residential schools read high school materials. Generally, students in this sample read at a lower level than might have been expected from their grade placement.

Mode of Reading: Table 3 presents a summary of the data obtained when Ss were asked which mode of reading they used most frequently, regular sized print or large type.

Table 3

Mode of Reading Most Often Used

Schools	n using L-T most	%	n using Print most	%
Public Day Schools n = 27				
elementary	6	100%	0	0%
Jr. High	5	42%	7	58%
Sr. High	1	11%	8	89%
Residential School n = 17				
elementary	3	100%	0	0%
Jr. High	9	100%	0	0%
Sr. High	7	100%	0	0%

All Ss who attended the residential school for the blind used large type most frequently as did public school children in the elementary grades. However, public school children in the junior and senior high grades used regular sized type most often. This was particularly true for senior high students.

Reading Errors: The mean number of errors made when reading in each mode are presented in Table 4. Also presented are mean difference scores for comparisons between microfiche and large type, print and large type, and print and microfiche.

Table 4

Mean Errors and Mean Difference Scores by Mode

	Print (P)	Large Type (LT)	Microfiche (M)	M-LT	P-LT	P-M
Residential School n = 17	16.82	12.24	15.65	3.41	4.59	1.18
Public School n = 29	26.69	24.79	26.38	1.55	2.34	.31
TOTAL	23.04	20.15	22.41	2.24*	3.17*	.63

*Mean difference significant at .05 level of confidence

Using procedures for correlated means, t-tests were made to determine the significance of these differences. Reading errors were significantly greater (.05 level of confidence) for microfiche reading when compared with large type reading (t = 2.40) and for regular print reading when compared with large type reading (t = 2.50). However, differences in errors between microfiche reading and regular print reading were not significant (t = .63).

Type of Reading Errors: The types of reading errors according to the categories used in Gray's Oral Reading Test were determined for each mode. The pattern of errors for each mode was then compared by means of a Chi Square Test. The number of errors and the percent errors for each category within each mode is presented in Table 5.

Table 5

Types of Oral Reading Errors
for the Three Media

Type of Error*	1	2	3	4	5	6	Total
Large Type							
Number	156	7	109	329	87	240	928
Percent	17	1	12	35	9	26	100
Regular Print							
Number	171	20	164	377	73	257	1062
Percent	16	2	15	35	7	24	100
Microfiche							
Number	182	14	95	401	83	256	1031
Percent	18	1	9	39	8	25	100
Total							
Number	509	41	368	1107	243	753	3021

*1	Words Mispronounced
2	Syllables Mispronounced
3	Omissions
4	Substitutions
5	Insertions
6	Repetitions

Types of errors in order of frequency of occurrence were Substitutions, Repetitions, Word Mispronunciations, Omissions, Insertions, and Syllable Mispronunciations. While the distributions of errors appear similar for the three modes of reading, a chi-square test for similarity yielded a value of 28.84 which was significant at the .01 level of confidence. The only points at which the error distributions seriously depart is for Omissions where microfiche has the fewest (9%) and regular print the most (15%), and for Substitutions where microfiche exceeds the other two modes by 4%. As indicated earlier, fewer errors were made by the students when they read large type.

Reading Time: Mean reading times for both groups for the three modes of reading are given in Table 6. Residential school students' means are greater for all modes. Also given in this table are mean differences between modes. Large type reading took significantly less time than that required for either microfiche or large type when total group scores are considered. There was no statistical difference between the times required to read regular print and microfiche.

Table 6

Mean Reading Times in Seconds

Source	Mean Times Print	 Large Type	 Microfiche	Mean Differences P-LT	 M-LT	 P-M
Residential	251.76	205.29	246.35	46.47	41.06	5.41
Day School	215.27	197.51	211.48	17.76	13.97	3.79
Total	228.76	200.39	224.36	28.37**	23.97*	4.40

* Mean difference significant at .01 level of confidence (t = 3.47)
** Mean difference significant at .05 level of confidence (t = 2.46)

Conclusion

The purpose of this study was to explore the relative efficiency of large type, regular print, and enlarged microfiche displays as reading media for visually handicapped students. Overall, large type appeared significantly better in terms of number of reading errors and time required for reading. While error differences were not great in an absolute sense, time for reading the other media was more than 10% greater than that required for large type. Differences in relative efficiency of reading were greater for the more severely handicapped students.

From a practical standpoint, the differences were not so great as to prohibit the use of enlarged microfiche displays as a means of supplying materials to visually handicapped students when no other source is available. This is particularly true for students who are not so severely handicapped. Lack of experience with the microfiche may have contributed to the inferior performance by students with this mode. Consequently, ultimate performance with this medium may be better than indicated by this exploratory study.

Task 3 Exploring the usefulness of the VIP Masterlens

Project Personnel Carson Nolan and June Morris

Purpose

Many visually handicapped students have sufficient vision to use print if the size of the image can be made large enough. Ways in which this can be done include reprinting materials in 18 or 24-point type, use of enlarged projections of microfiche or other media, closed circuit television displays, or through a direct use of magnifiers.

The IMRC at APH assembled sets of magnifiers which were available for loan on a national basis. As part of this project, magnifiers of all kinds were reviewed. One of the more formal reviews concerned the usefulness of the VIP Masterlens. This magnifier was selected for more formal review because of the extensive claims made for its usefulness to the visually handicapped by its distributor.*

Procedure

The study was conducted in two stages. In the first stage, teachers used the magnifiers with visually handicapped students over a three month period. Included were three resource room and four itinerant teachers from the Chicago Public Schools and four itinerant teachers from the St. Louis County Special School District. After use of the device, teachers completed a questionnaire for each student user which provided descriptive information about the user and answered questions about the child's ability to use the device. These questions included items on physical adjustment required of the child when using the device, ability to set up and take down the device, types of material with which the magnifier could be used, glare problems experienced, modifications needed for the device to be more effective, and willingness to purchase the device for use by each child.

In the second stage of the study, reading performance of visually handicapped students was compared for regular print, regular print read under the magnifier, and large type. Students participating first practiced one hour on each of three consecutive days reading high interest regular print materials under the magnifier. On the fourth day, each student read equivalent stories at an appropriate reading level in the three reading modes, 18-point large type, regular print, and regular print under the magnifier. Order of presentation of these materials was counterbalanced among individual students for the test.

Reading times and reading errors were recorded for each individual. Errors recorded included repetitions, insertions, mispronunciations, substitutions, and omissions. Differences between reading times and total errors for the three modes were analyzed using analysis of variance techniques for matched groups.

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*The Ednalite Corporation, Ande Bldg., Peckskill, NY 10566

Subjects

Fifty-three large type readers, 22 of whom were legally blind, used the magnifier in the classroom setting. These students were enrolled in public school classes in the Chicago Public Schools and in the St. Louis County Special School District. A breakdown of this group by grade, vision, and sex appears in Table 1.

Table 1

Description of Students Who Used Magnifier in the Classroom and in the Reading Performance Study

Grade	Vision		Sex	
	Better than 20/200	Less than 20/200	Male	Female
Classroom Users				
1-4	12	4	11	5
5-8	12	9	15	6
9-12	7	9	7	9
Reading Performance Study				
6-8	2	8	5	5
9-12	3	20	12	11

Thirty-three large type readers, 28 of whom were legally blind, participated in the reading performance study. These students were drawn from grades 6-12 of the Florida School for the Deaf and the Blind. A breakdown of this group by grade, vision, and sex also appears in Table 1.

Materials

The magnifier used was the Ednalite Masterlens with Ramalite which is a large portable device with folding legs. The viewing area of this magnifier is 44.5 square inches and the lens is rectangular in shape with a 9 inch diagonal. Resolution was 7.9 lines per millimeter, distortion was 2% or less, and maximum chromatic abberation was 1.5%. Depth of field and working distance were 10 inches minimum. The Masterlens tilts in a complete 360 degree arc. Mounted independently to the lens are twin GEF4T5/CW standard lamps with built-in ballast which provide adjustable, cool, glarefree illumination uniformly distributed over the entire viewing area. The twelve magnifiers used in these two studies were furnished on loan by the Ednalite Corporation.

Students in the public schools used the magnifiers to read all the variety of materials commonly used for school work in the classroom and at home.

In the reading performance study, students practices reading with the magnifier for a total of three hours using a variety of high interest-low vocabulary stories. For performance testing, three passages of equal length and difficulty were selected from a fifth grade reader. Reading difficulty was determined by methods described by Flesch (1951). Information about the source and the passages is as follows:

McCracken, G., & Walcutt, C. C. Basic Reading (5). New York: Lippincott, 1965.

"Freddy Applegate Hunts Treasure"

BR 1	246 words	easy-fairly easy
BR 2	241 words	fairly easy
BR 3	242 words	fairly easy

Each of the three passages was made available in two forms. The regular ink-print edition was used for reading in both regular inkprint and under the magnifier. The large type edition was reproduced in 18-point type by APH.

Results

A total of 53 students was observed using the magnifier in public school classes. For only one of the 22 legally blind students was the device judged useful. Of the 31 students whose vision was better than legal blindness, the device was judged useful with nine. Expressed another way, the magnifier was judged useful with 19% of the total group, with less than 5% of the legally blind group, and with 29% of the better sighted group.

Of comments made by teachers, most were negative or suggestive of improvements. Statements summarizing these comments are as follows:

1. The device was too heavy, awkward, cumbersome, or unstable for the child to manipulate.
2. Magnification was insufficient for many students.
3. Adjustment of relative table, magnifier, and chair height was a frequent problem.
4. Positioning and holding materials under the lens was difficult.

In the reading performance phase, 5 of the 33 original subjects were unable to use the magnifier at all. Consequently, the data to be reported here are based on performance of 28 subjects. Mean reading times and mean error scores for the three modes of reading are given in Table 2.

Table 2

Reading Performance: Means and Standard Deviations for Measures of the Three Modes of Reading

	Large Type		Regular Print		Magnifier		N
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Reading Time (Minutes)	3.57	2.61	3.72	2.69	4.66	3.07	28
Reading Errors	26.89	22.68	25.64	22.70	37.25	25.23	28

Differences between these means were analyzed using analysis of variance between repeated measures and the differences among pairs of means then analyzed by t-tests. Reading times were significantly different (.01 level of confidence) between large type and magnifier and between regular print and magnifier. No significant differences were found between large type and regular print. Reading with the magnifier took 25% longer than reading large type. Similar differences were found for reading errors. Errors for reading large type and print were same, however, errors for reading with the magnifier were significantly greater (.01 level of confidence) than either of these. Magnifier errors exceeded those for large type by 38%. Comparatively speaking, only 3 students out of 28 read faster with the magnifier and only 2 students made fewer errors.

A surprising finding was that for the 28 legally blind students in this study, reading performance for large type and regular print was equivalent. Use of the magnifier seriously disrupted reading of the regular print passages.

Summary and Conclusion

The Masterlens magnifier was evaluated through use in public school classrooms by 53 large type readers and through comparison of reading performance of 28 large type readers in a residential school who read equivalent passages in regular print, regular print with magnifier, and large type. Teachers' observations of students' performance indicated that the magnifier was useful only with a small portion of the less severely handicapped. Many design and use problems were identified. In the performance study, reading regular print with the magnifier was inferior to reading of large type or regular print alone in terms of both reading speed and reading errors. Consequently, it was concluded that this magnifier has quite limited usefulness.

Task 4 Evaluation of paper types for braille magazines

Project Personnel June Morris and Carson Nolan

Purpose

For many years APH has printed and distributed braille magazines. These magazines range from weeklies to annuals and comprise hundreds of thousands of pamphlets each year. Currently, over 50 different magazines are produced on a regular schedule. While some are for special interest groups, others include nationally known magazines such as National Geographic, Children's Digest, My Weekly Reader, Fortune, and Reader's Digest. The latter was first published in braille in 1928 and has continued to be throughout the ensuing 46 years.

Braille magazines are printed on web fed automatic presses. The paper used in their production is a special heavy paper that is printed dry as contrasted to that used for braille books which is printed, or embossed, when damp. Whether for braille magazines or books, the paper used must be of a quality that will yield a firm dot and not split when embossed.

In 1969 APH's Plant Manager requested help in evaluating several types of paper being considered for use in braille magazines. Although the paper being used was quite satisfactory, it was expensive and of limited availability. Consequently, an effort was being made to replace it with something that would be less expensive and more readily obtainable. If this could be achieved, the cost savings could be reflected in the price of the end product; namely, braille magazines. Two factors were to be considered. These were quality of the braille, a factor on which APH personnel were well qualified to judge; and user preference, the factor tested and reported here.

Procedure and materials

The method used to determine user preference was to have blind persons who were experienced readers of braille rank the papers being considered for use in braille magazines according to their preference. This was done in two sequential steps. In the first, two trial papers (O.K. and Chatfield) were compared with the paper in use at that time (International). In the next step the two papers obtaining the highest ranks in the first step (International and Chatfield) were compared with two other trial papers (a white paper [all others were brown] and International Flat which was similar to but slicker than International).

In each step the papers being compared at the time were printed, or embossed, identically with selections from Reader's Digest. The same plates and press were used in printing each of the papers; therefore, any variance occurring between them was a function of the paper used rather than how they were produced.

In both phases of the study, the papers to be compared were coded and arranged in packets within which they were randomly ordered. The task for each subject was to read a little from each of the papers within the packet he was given and then to stack the papers in the order of his preference with the one he liked best on top and the one he liked least on the bottom. The experimenter then recorded how the papers were ranked.

Subjects

All subjects were readers of braille. Some were students, some were adults. In the first phase of the study, 42 participated. Of these, 32 were students enrolled in summer programs at residential schools for the blind (7 from the Indiana School for the Blind at Indianapolis and 25 from the Ohio State School for the Blind at Columbus) and 10 were adults who were regular employees of APH. In the second phase of the study, 45 subjects participated. These included 25 students from the Indiana School for the Blind and 20 adults, 18 of whom were employed by the Kentucky Industries for the Blind and 2 of whom were employed by the Indiana Industries for the Blind. Subjects worked together in groups assembled at the various sites where they either attended school or worked.

Results

Tabulation of data for the first three papers compared showed the regular paper (International) to be far more popular than either of the two trial papers. It was preferred by 69% of the subjects while only 24% and 7% preferred the Chatfield and O.K. papers, respectively.

Results of the second phase of the study showed the International Flat paper to be preferred by 40% of the subjects, the white paper by 24%, International by 20%, and Chatfield by 16%.

No further analyses were made.

Summary

At the request of the Plant Manager of APH, several types of paper for possible use in braille magazines were evaluated as to their desirability by readers of braille. As a result, a paper called International Flat was found to be the most preferred. This paper is similar to but slicker than the paper in use in braille magazines at the time of the study. It was found to be preferred by twice as many of the subjects as the paper being used.

Conclusions

Following identification of a suitable paper for use in braille magazines, it was adopted for this purpose. The new paper, International Flat, makes a good firm braille dot, is preferred by users over its predecessor, is cheaper than its predecessor, and is more widely available than its predecessor. Its adoption should mark an improvement in all respects for braille magazines.

Task 5 A user test of the upward writing braille slate

Project Personnel Carson Nolan

Purpose

The least expensive portable device for writing braille is the slate and stylus. Traditionally, braille dots are embossed with this device by pressing the paper into a conically shaped depression with a pointed stylus. This technique requires that braille be written as the mirror image of printed braille or in reverse from right to left. This requirement has long been of concern to educators of young blind children and of the newly blind adult. The necessity for those who learn braille to learn to read one set of images and simultaneously learn to write the reverse of these images has, because of the interference or extrinsic inhibition involved, caused many learning problems. However, for young blind children, the current practice (Rawls and Lewis, 1961) of teaching children to write on the braillewriter instead of the slate has eliminated this difficulty.

Over the decades, a solution to this problem has been sought in the design of a slate and stylus that would enable the user to write from left to right. Generically labeled "upward writing slates," these devices emboss braille dots by pressing paper down over a conical projection by means of a stylus with a hollow tip. The first patent for such a device was filed in the 1850's and versions have appeared intermittently since. No design has ever received a degree of acceptance sufficient to warrant manufacture. Recently, two new versions of the upward writing slate have appeared. Because of the publicity these have received, interest in the device has once more been stimulated.

The reasons for previous rejection of these devices are several and they vary. Some of these are listed below.

1. The upward writing stylus lacks "homing" capability. In the downward writing slate, even if the stylus is pressed off-center of the conical depression, it tends to slide into and toward the center of the depression. In the upward writing slate, the stylus, if not centered, may slide off the side of the conical projection only partially embossing a dot or without embossing a dot.
2. The upward writing slate fails to provide information to the user that a dot has been made. Downward writing slates are designed so that the termination of the embossing action is accompanied by a slight rupture of the surface of the paper. This results in an audible click and provides information that a dot has been made. The operation of upward writing slates does not result in this sound and the user has no information as to whether he has actually embossed a dot.
3. The lack of homing properties in the stylus and the lack of information as to whether a dot actually has been made tend to reduce writing speeds for the upward writing slate.

4. Because of the mechanical properties of the embossing action, embossing a dot on an upward writing slate can cause a low image of an adjacent dot to appear unintentionally. These unwanted images are called "ghost dots."

The recent advent of two upward writing slates stimulated requests that the APH IMRC help in the evaluation of these. The subsequent recall of one slate by its designer halved the problem. The remaining slate was that designed and described by Barr (1968). Plans for an extensive evaluation of this slate during the 1967-68 school year were thwarted by inability to obtain funding for production. However, a limited evaluation was conducted in May 1968.

Subjects

Because of the small number of Barr slates available, the number of subjects used in the evaluation was restricted to 19. All subjects were braille readers. Involved were six high school students, five fourth grade students, two fifth grade students, and six students from grade six. Eleven girls and eight boys were included. Fourth grade students had used the Barr slate exclusively for the previous two years, but had no experience with the downward writing slate. The other subjects had used the downward writing slate, but had no experience with upward writing slates.

Procedure

All students were given training for approximately one-half hour on each of eight school days on the slate with which they had least experience. At the end of training, they were required to write approximately eight lines of the same material on both the upward and downward writing slates. The material written was selected for appropriateness for grade level in terms of reading difficulty and was selected so as to contain a proportionate number of lower braille signs. Subjects either copied these materials or wrote from dictation. Regular braille paper was used with the downward writing slate while a special plastic paper designed to eliminate "ghost dots" was used with the Barr slate.

Criterion for Evaluation

Since the uncontrolled experience factor tended to bias each student's performance in the direction of one of the two slates, it was decided to use quality of braille produced as the criterion. Selection of this criterion de-emphasized performance factors such as rate and centered attention on problems identified as critical for upward writing slates in past evaluations.

The materials written by each student were read tactually by a blind braille proof reader at APH and all errors recorded. These included spelling, braille code errors, illegible braille, added dots, weak dots and ghost dots.

These error records for each student and each slate provided the total error data upon which the evaluation was based.

Results

Table 1 presents individual scores, mean grade socres, and mean total scores for the total number of errors and for the braille errors for each slate. Braille production errors include illegible braille, added dots, weak dots, and ghost dots. If the material on a sheet was illegible the number of errors was made equivalent to the number of words to be written.

Table 1

Individual Errors, Grade Mean Errors and Total Mean Errors for the Total Number of Errors and for Braille Production Errors for Each Slate

Grade	Total Errors		Braille Production Errors	
High School	Upward Slate	Downward Slate	Upward Slate	Downward Slate
Subject 1	13	5	1	1
Subject 2	34	7	7	0
Subject 3	11	2	1	0
Subject 4	10	8	1	1
Subject 5	8	5	2	2
Subject 6	25	10	2	1
Mean	16.83	6.02	2.33	.83
Grade 6				
Subject 1	32	3	3	0
Subject 2	12	3	3	0
Subject 3	14	0	2	0
Subject 4	33	13	6	1
Subject 5	12	21	4	3
Subject 6	52	6	52	0
Mean	25.83	9.20	11.67	.80
Grade 5				
Subject 1	34	16	34	2
Subject 2	32	5	0	0
Mean	33.00	10.50	17.00	1.00
Grade 4				
Subject 1	25	37	19	37
Subject 2	53	29	53	1
Subject 3	49	23	49	4
Subject 4	11	11	6	0
Subject 5	49	12	47	0
Mean	37.40	22.40	34.80	5.25
Total Mean	26.79	11.37	15.37	2.79

Inspection of Table 1 reveals that for both total errors and braille production errors the number of errors found was consistently greater for the upward writing slate over all grades. Analysis of results combined over all grades using the Wilcoxon Matched-pairs Signed-ranks Test revealed that differences between slates for both error categories were statistically significant beyond the 5% level of confidence.

For the total group, use of the Barr slate resulted in 236% more errors of all kinds when compared with the downward writing slate. Braille production errors were 551% greater when the Barr slate was used. Of special interest is the performance of the fourth grade which had been using the upward writing slate for two years. For these pupils, use of the upward slate when compared with the downward slate resulted in 167% more errors of all kinds and 663% more braille production errors.

One particular error of interest was the appearance of ghost dots. Visual inspection of the braille material revealed many more visually apparent ghost dots for the material written on plastic paper on the upward writing slate. Tactual reading of the material picked up 25 ghost dots in the material written on the upward writing slate as compared with 13 such errors for the traditional slate. Test of these differences by use of chi-square indicate that the level of significance closely approaches 5%.

Discussion

The results of the present study in no way offset the negative conclusions arrived at over the last century concerning the feasibility of upward writing slates. The significantly higher error rates achieved with this slate are great enough to be of practical significance to educators. While sources of these errors are not identified by the study, it is speculated that their source lies in the perennial twin difficulties of lack of stylus homing capability and lack of information as to whether a dot has been formed. It is true that the preponderence of subjects lacked much experience with the upward slate and that this constitutes a bias in the outcome of the study. Yet the fact that students in grade four with two years experience with the upward writing slate present a similar picture to the other grade groups implies that the bias may not be critical.

The sole positive element in the findings is the steady decrease of errors with increase in grade level. Even this decrease favors the traditional slate. However, its existence may imply that upward writing slates may be usable by mature individuals with well developed patterns of muscular coordination. However, the study results do confirm that many or most students, even at the high school level, lack the manipulative ability necessary for successful use of the upward writing slate.

Informal interviews were conducted with the participants after they had an opportunity to use the device. Questions concerned possible uses to be made of the machine, advantages of the machine, and disadvantages.

Subjects: Persons interviewed included one blind dictaphone typist, one blind professional, three blind teachers, three sighted typing teachers, and two sighted school administrators.

Results

Interviewees made 47 qualitative statements about the device, 16 of these were positive in nature and 31 were negative. Blind adult users felt the machine would be useful to help find ones place when interrupted while typing and to check for mistakes on copy. One blind user felt he would do much more typing if he could check his own work. Typing teachers thought it would be useful to demonstrate actual errors the student was making. Typists felt it would be useful to proofread letters. However, this would have to be done line by line severely slowing typing speed. Waiting until the end of a full page letter would not be possible, since this would generate 121 feet of tape which could not be managed with the present design of the machine.

Typing teachers generally felt that routine use of the machine would slow skill development in beginning braille readers. However, most of their negative comments and those of other users dealt with problems in machine performance.

As the machine was designed, it was not possible to capitalize in braille. Typing at over 30 words per minute caused the typing rate to overrun the braille rate and the braille characters piled up on one another on the tape. The braille attachment would not backspace. Uneven stroking of the typewriter keys caused the braille attachment to overprint. If keys were activated too closely together in time, only the first character would reproduce in braille. Some users commented that the typewriter, when coupled with the braille attachment, sat too high for comfortable use.

All users felt that the cost of the device, estimated from $800-$900 was far too high to make it of practical use, particularly to individual blind users.

Conclusions

On the bases of the comments obtained during the pilot survey, it was decided that in terms of cost alone the device would not be practical. Even at a reasonable cost, current problems and limitations in design were such that manufacture and distribution for use by the blind was not warranted.

Task 7 Competencies needed by teachers of the visually handicapped

Project Personnel Roy Brothers

Purpose

In planning the APH IMRC, one of the three major goals was to provide a means of communicating and demonstrating the availability and methods of use of materials to educational programs and teacher training facilities. It was recognized that the education of visually handicapped children would be directly affected by the competencies of the teachers involved. Competency within this context was directly related to the use of educational aids especially designed for the visually handicapped.

The purposes of the present study were twofold. First, to identify educational target areas that require specialized teacher knowledge or competency, and second, to identify problems associated with incorporating target needs into common practice.

Procedure

Seventy-six educational programs serving visually handicapped children (VHC) in public and residential schools were sent a four page questionnaire concerning needed teacher skills and competencies which could or should be strengthened. The questionnaire was addressed to the person with the highest administrative title at each location. The questionnaire was answered by superintendents, directors, principals, and supervising teachers. Questionnaires were returned by 34 of the schools contacted which represented a return of approximately 45%.

Respondents to the questionnaire indicated those areas of inservice training which had occurred or were planned (i.e., questions 1 and 2). An assumption was made that the inservice training conducted or planned would accurately reflect the needs of the staff as perceived by the administrator. The needs of teachers in four subject matter areas were also identified. These areas as represented by question 3 were: reading, mathematics, science, and social studies. Question 4 was used to identify those skills in the specialized areas of listening, low vision, and educational diagnostic procedures. Although these areas of competency cut across most subject matter categories, they appear to be especially important to teachers of VHC. A final question was related to problems associated with conducting inservice training.

A separate questionnaire was included for the teachers within the system. The teachers were asked to recall recent inservice experiences and to list special skills that were presented and which had been especially useful. A second question asked what type of inservice or dissemination procedure would assist them in becoming a more effective teacher.

A special meeting of leading educators was convened in October, 1972 to explore further the problems associated with inservice training and the possible approaches that might be used to increase their effectiveness.

Results

Inservice experiences: A total of 136 inservice experiences were listed in response to questions 1 and 2 (i.e., past and proposed topics for inservice programs). For purposes of reporting, they were organized into four lists: 1) experiences related to the general preparation of teachers of VHC, 2) specific skills needed by teachers of VHC, 3) experiences related to present and future needs of VHC, and 4) miscellaneous topic areas. The listings of inservice experiences have been reported in Tables 1 through 4. In addition the frequency of such experiences have been noted. The entire list of 136 topics represented a mean topic per school of 4.0. The inservice experiences represented those conducted during the past three years plus those planned for the coming year. Consequently, not more than one major inservice effort might be expected at any one school during an academic year.

Table 1

Frequency and Listing of Inservice Experiences Related to General Preparation of Teachers of VHC

(f)		Topic of Inservice Experience
11	*	Learning problems associated with multi-handicapped children
11	*	Educational diagnostic procedures
5		Exceptional children (i.e., hearing impaired, deaf-blind, E.D. etc.)
6		Behavior modification
5		Child development
4		Use of available resources (i.e., inter-agency cooperation, IMC services, integration into regular classes, field trips, etc.)
2		Writing instructional objectives
2		Individualized instruction
2		Math concepts and fundamentals
2		Anatomy and physiology of the eye
1		Modern math
1		How to study skills
1		Perceptual training
53		Approximately 39% of the inservice experiences reported

* Inservice experience listed on the questionnaire which only required a check.

Table 2

Frequency and Listing of Inservice Experiences Related to Specific Skills Needed by Teachers of VHC

(f)		Topic of Inservice Experience
17	*	Orientation and pre-mobility concepts
15	*	Use of low vision aids
8	*	Daily living skills
6	*	Listening skills (aural learning)
5		Developing low vision efficiency
4		Teaching the abacus
4		Braille reading and writing
3		Preparation and use of aids and materials
2		Methods and materials in education of VHC
1		Techniques for improving posture
1		Nemeth code
1		Tips on typing
1		Rhythmics
68		Approximately 50% of the inservice experiences reported

* Inservice experience listed on the questionnaire

Table 3

Frequency and Listing of Inservice Experiences Related to Present and Future Needs of the VHC

(f)	Topic of Inservice Experience
2	Vocational education
2	Drug use and associated problems
1	Home mechanics
1	Occupational training for multi-handicapped
1	Work training experiences
1	Social skills
1	Future of mentally retarded blind
1	Social and vocational aspects of limited vision
10	Approximately 7% of the inservice experiences reported

Table 4

Frequency and Listing of Misscellaneous Inservice Experiences

(f)	Topic of Inservice Experience
3	Teacher effectiveness: Use of micro-teaching with video-tape, effectiveness training, and development of handbook for educators of VHC
1	Human sexuality
1	Fire control, prevention
5	Approximately 4% of the inservice experiences reported

The topics reported most frequently in Table 1 (i.e., general preparation) appear to reflect the schools' concern for children with multiple handicaps, and the need to develop diagnostic and individualized programs of study. The specific skill topics most frequently mentioned in Table 2 were orientation and pre-mobility concepts, use of low vision aids, and, to a lesser extent, listening and daily living skills. Those topics which emphasized future and present needs of the students were relatively few in number, representing only 7% of the topics listed.

Results obtained relative to question 3 were organized by curricular area. However, the focus of the study was concerned with the use or adaptation of educational materials especially designed for VHC; consequently, the tables as categorized represent these types of abilities. Tables 5 through 8 represent specific needs within curricular areas that were related to materials. The skills thus identified have been used already to select target areas for the development of special instructional manuals and other activities which will meet specific needs within the field.

Table 5

Competencies Related to the Use of Materials for Reading Instruction

(f)	Needed Teacher Competencies
4	Ability to provide meaningful and interesting materials
3	Ability to select appropriate programs and materials
1	Ability to provide for sequential development of materials
1	Ability to use aids in remediation techniques

Table 6

Competencies Related to the Use of Materials for Mathematics Instruction

(f)	Needed Teacher Competencies
17	Ability to use and teach use of the Cranmer Abacus
3	Ability to adapt materials for demonstration of concepts with knowledge of which aids contribute to specific concepts
3	Ability to select and use appropriate aids with tactual orientation
2	Ability to develop a readiness program
2	Ability to develop materials to teach geometry
2	Ability to develop materials and instructions for teaching metric measurement
1	Ability to develop diagrams which demonstrate spatial relationships
1	Ability to use braillewriter for computation

Table 7

Competencies Related to the Use of Materials for Social Studies Instruction

(f)	Needed Teacher Competencies
4	Ability to utilize maps, charts, globes, tactual aids
3	Ability to prepare and/or produce visual maps, models, etc.
3	Ability to develop a method of map reading
1	Ability to adapt materials from a standardized text
1	Ability to produce adapted materials
1	Ability to teach concepts using a tangible apparatus
1	Ability to increase availability of maps and map studies
1	Ability to develop methods and materials to bring social topics into focus
1	Awareness of complete resources (information about materials & apparatus)
1	Ability to incorporate role playing situations on tape*
1	Ability to instruct students in use of audio-devices*
1	Knowledge and use of audio-visual and tactual materials*
1	Ability to use a listening skills approach*

* Assumes some skill in using aural materials

Table 8

Competencies Related to the Use of Materials for Science Instruction

(f)	Needed Teacher Competencies
9	Ability to arrange meaningful experiments for totally blind students which include adaptations for participation and development of a scientific approach
6	Ability to adapt laboratory apparatus and models for use by blind students
5	Expertise in the use of science equipment
1	Ability to use sound and/or similar substitute systems in lab work (i.e., light probe)
1	Ability to use tangible aids

Of the 60 competencies reported for the area of reading approximately 15% dealt with the effective use or development of materials. Sixty-five skills or abilities were reported as needed in the area of mathematics and approximately 43% were related to the use and/or development of materials. It was interesting to note that over half of the responses were related to the use of teaching the use of the abacus.

Similarly, 35% of the skills listed as needed for social studies instruction dealt with the use or development of materials. Approximately 48% of the skills listed for science instruction were related to the effective use or development of materials.

Question 4 was concerned with teacher competencies which cut across curricular areas. The respondents were asked to list specific skills or competencies needed by teachers of VHC as they related to listening skill development, utilization of low vision, and educational diagnostic procedures. Those skills realted to the utilization or preparation of materials in these three areas appear in Tables 9 through 11.

Table 9

Competencies Related to the Development of Listening Skills

(f)	Needed Teacher Competencies
5	Ability to use all available equipment & materials (e.g. tapes, records, players, etc.)
5	Ability to identify and use materials appropriate for teaching listening skills to VHC.
2	Ability to prepare instructional tapes including compressed speech
2	Ability to develop guides for teaching listening skills to VHC
1	Ability to maintain equipment (i.e., "care and feeding")
1	Increased awareness of material that can be used by the student
1	Ability to prepare taped lessons and exercises for individual students
1	Ability to develop a listening curriculum
1	Ability to devise games which correlate with listening skill development
1	Ability to locate and/or prepare test materials

Table 10

Competencies Related to the Utilization of Low Vision

(f)	Needed Teacher Competencies
5	Ability to teach uses of devices for LVS
3	Awareness of different devices for LVS (i.e., magnifiers, etc.)
2	Ability to teach and supervise use of low vision aids
1	Ability to use all available learning sources
1	Gain more information on types of low vision aids
1	Ability to use aids
1	Ability to adapt suitable materials
1	Ability to utilize filmstrips with personal projector and screen
1	Ability to devise a readiness program for establishment of positive habits
1	Ability to teach abacus beyond addition and subtraction

Table 12

General Competency Inservice Programs Reported as Especially Useful to the Teacher

(f)	Useful Inservice Experiences
9	Behavior modification
9	Behavioral diagnostic approach to learning and writing instructional objectives in behavioral terms
6	Opportunities for discussion with fellow professionals in both special education and regular education
4	Educational techniques related to exceptional children
4	Services and functions of a diagnostic center
3	Psychology of exceptional children
3	Sequencing subject matter
3	Reading workshop
3	Parent-child institute
2	Individualized mathematics
2	Curriculum planning
2	Classroom management contracting
2	Individualized programming
2	Parent counseling
2	Where to order materials
2	Learning disabilities
1	Availability of materials from Library of Congress
1	Potential field trips
1	Workday experiences
1	Education of EMR blind child
1	Information regarding multi-handicapped child
1	Working with the young child
1	Video-tape of deaf-blind child
1	Evaluation procedures and placement of deaf-blind children
1	Interpreted research
1	English workshop
1	Elementary science workshop
1	Care and prevention of athletic injuries
1	Sensory stimulation
1	Preparation of etiquette handbook
72	Total

Table 13

Specific Competency Inservice Programs Reported by Teachers as Especially Useful

(f)	Useful Inservice Experiences
21	Orientation and mobility skills for VHC
21	Low vision institute: use of low vision, administration of visual discrimination test, aids used by low vision students
19	Reading and writing braille
12	Use of the Cranmer abacus
10	Anatomy and physiology of the eye in relation to learning
8	Voice
6	Communication with deaf children including sign language, sentence patterns
3	Use of variable speed record player, and other recording equipment
3	Bridging the gap between medical diagnosis and educational prescription (how to read forms used by ophthalmologist)
3	Motor skills and development of VHC
2	Using tangible aids including audio-visual aids
2	Making teaching aids
2	Daily living skills
2	Development of spatial relations, positional and visual orientation
1	Methods of reducing print size
1	Information on teaching aids
1	Use of Language Master cards, tapes and cassettes
1	Schott experimental mathematics curriculum
1	Nemeth code
1	Development of listening skills
1	Creative movement
1	Teaching techniques for late blinded children
124	Total

Table 14

Other Inservice Programs reported by Teachers as Especially Useful

(f)	Useful Inservice Experiences
2	Communications: Teacher effectiveness training, active listening
2	Empathy workshop
1	Sensitivity training
1	Personal evaluation
1	Fire prevention, student safety
7	Total

Called meeting: At the 1972 Annual Meeting of Ex Officio Trustees of the American Printing House for the Blind, 20 educators met in a called meeting to discuss problems associated with the inservice training of teachers.

Those in attendance carried major responsibilities for the education of visually handicapped children in the United States. Personnel from public and residential schools attended as did educators associated with several teacher training institutions.

The meeting was called to discuss problems associated with the effective dissemination of information, but more specifically to explore those avenues of information dissemination directly related to educational materials for visually handicapped students. During the course of open discussion, several problem areas were identified and in some instances possible solutions were obtained from the group.

Successful inservice experiences depend on access to resources both personal and material, as well as the support and cooperation of the school administration. One has only to look to the area of orientation and mobility to recognize the effect of having a great many specialists available for conducting inservice experiences. The personnel were available, the area lent itself to teaching basic conceptual and fundamental skills, and the need was completely supported by the educator who exercised administrative control. The result has been a relatively high saturation of effective inservice experiences in orientation and mobility.

Basically, the problems identified by the group were: 1) the availability and training of expert resource persons, and 2) the inservice process itself. Providing for the availability of resource persons was first discussed in relation to serving areas of low population density. In another instance the availability of experts was tied to the question of scheduling. In many instances, inservice training has been scheduled at the beginning of a school year or other times when inservice becomes a statewide activity. The result is that the available persons are caught in a scheduling crisis. In some instances, a desired inservice may be postponed or deferred indefinitely because of a lack of trained personnel.

It had been pointed out that the teachers in responding to the questionnaire preferred a live expert over a canned programmed instruction. In response, it was noted by one member of the group that at present relatively few instructional packages are available and that the packaged instruction has not utilized the media to its greatest advantage or potential. Greater sophistication is needed in preparing instructional packages and efforts should continue to develop them. More effective use of video-tape, T.V., and recorded cassette instructions were noted as examples.

It was generally agreed that one possible solution to the problem of availability of experts was to encourage regional types of planning. It was felt that functioning state organizations in conjunction with a teacher training institution and an SEIMC would have the resource expertise required to deliver the necessary services to individuals or schools. The regional concept could easily develop into special studies institutes which, according to the group, were the most desirable organizations for effective inservice training.

The question of funding was discussed but was not generally felt to be a problem. This was especially true if a regional or state approach was used. It was noted that funds were available under P.L. 89-313 for purposes of inservice training.

The next major concern of the group was in regard to the dissemination of the skills or information, the training of experts and ultimately classroom teachers. It was noted that the technique of filtering down information generally resulted in a diluted informational product. The excitement and motivational aspects of a good presentation were often lost in the transmission.

Another problem was expressed in the notion that inservice training should not be considered as a one time solution for a problem. There should be some technique developed to assure follow-up on the skills introduced in inservice training. Again, a possible solution was suggested. It would encourage the practice of training the master teacher and the supervising teacher in the desired techniques for transmission to the general target population of teachers. It would allow the expert to observe and reinforce the types of teacher behavior which would contribute to a successful teaching experience.

The role of APH in the training of materials experts was discussed but no decisions were made. The entire question of responsibility was by-passed. It was suggested that APH was a logical agency to supply the expertise regarding their own production materials. Another suggestion was made to utilize school supply fairs but several members had pointed out that a try-out period is needed to effectively utilize new materials.

The need to develop competencies in the area of listening skills was strongly expressed, but no other specific skills areas were targeted for action. In summary, it should be noted that the group ranked, in order of effectiveness, the special studies institute, the workshop, and finally the demonstration. The special studies institute would be possible with regional planning, and would have the advantage of providing follow-up and trial use of materials. The most obvious deficiency of the demonstration was its short term effect and failure to provide for active teacher involvement.

Task 8 Abacus instruction for teachers

Project Personnel Carson Nolan, Fred Gissoni, and Marion Lewis

Purpose

Mathematical computation continues to be a problem area for visually handicapped students (Brothers, 1972; 1973). The efficacy of the abacus is a computational device for visually handicapped students has been verified (Brothers, 1972; Lewis, 1970; Nolan and Morris, 1964), but use of the device, especially in public school programs, has been limited. In a recent study of arithmetic computation skills less than 15 percent of the students used the abacus for computation (Brothers, 1973). One possible explanation is that use of the abacus requires specialized information and proficiency on the part of the teacher before its introduction to the student. Opportunities for teachers to develop needed proficiency may be limited. Of the 31 institutions of higher education offering courses for teachers of the visually handicapped during 1972-73, only one referred specifically to abacus instructions (Association for Education of the Visually Handicapped, 1971). Similarly of the 26 programs listing courses for the 1972-73 academic year, only one offered a specific course for abacus instruction (Association for Education of the Visually Handicapped, 1972). Consequently, the purpose of this project was to develop a self-instructional program to enable teachers and others to add, subtract, multiply, and divide using the abacus.

Procedure

At the initiation of the project a consulting committee was selected composed of the following persons who were long experienced in abacus instruction. Three of the consultants were visually handicapped. The committee included:

Mr. Fred L. Gissoni, Supervisor, Kentucky Rehabilitation Center for the Blind

Dr. Mae Davidow, former teacher at Overbrook School for the Blind

Miss Janice Hattendorf, former instructor at Hadley School for the Blind

Mrs. Marion Lewis, former teacher at Tennessee School for the Blind

Specifications for the content were defined by the IMRC staff and reviewed by the consulting group. Revised specifications for the content were as follows:

Addition

The Abacus and Its Parts
Setting and Reading Numbers
Direct Addition
Indirect Addition
  Use of the 5-Bead
  Using Column at Left
  Tables for Indirect Addition
  Complete Addition Table
Decimal Fractions

Multiplication

Multiplication of a One-Digit Number by a One-Digit Number
One-Digit Factor by a Two-Digit Factor
  Direct Addition in Combining Products
One-Digit Factor by Factor Having More Digits--Indirect Addition Used
Factors Having Two or More Digits
Factors Having Zeros between Other Digits
Decimal Fractions

Subtraction

Direct Subtraction
Indirect Subtraction
  Use of the 5-Bead
  Using Column at Left
  Tables for Indirect Subtraction
  Complete Subtraction Table
Subtraction of Decimals
Differing Quantities

Division

One-Digit Divisor
Divisor Having Two or More Digits
Remainders
Downward Correction
Zeros within the Divisor
Division of Decimals

Generally, it was specified that the course consist of recorded lessons for each item in the content specifications. These lessons would describe each activity and auditorily lead the learner through samples of the procedure. A workbook would accompany the recorded lessons. For each item in the content, the workbook would provide examples of the operations involved with the steps in each sequentially listed. Sets of practice problems with correct answers given would be provided for each content item. At the end of each of the four major subdivisions, a set of general review questions (with answers) would be provided as well as a representative group of problems (with answers) to check the learners proficiency.

Consultant Gissoni was assigned responsibility for development of the recorded abacus lessons. A trial lesson was written and sent to APH project personnel and the other consultants for review. A two day meeting was held at the IMRC to review this lesson and suggest improvements in format and content. On the basis of this review, the initial lesson was revised and the format for the following lessons was defined.

The additional lessons required in the content specifications were next written by consultant Gissoni. These were sent to the other consultants who prepared formal reviews of each which were returned to the author. These reviews were thoroughly discussed by the reviewers and the IMRC project staff during a subsequent three day meeting at the IMRC. The recorded lessons were revised on the basis agreed upon during this meeting.

At this time consultant Lewis was assigned responsibility to write a draft of the workbook to parallel the recorded lessons as previously described. An additional specification was made that the steps in each operation be illustrated photographically to show the correct setting of beads on the abacus. Consultant Lewis drafted the workbook which was reviewed by Gissoni and the IMRC project leader. The workbook was revised on the basis of this review.

At this point in the project the grant terminated.

Conclusion

A self-instructional program for teachers was devised to teach addition, subtraction, multiplication, and division on the abacus. The program, which consisted of recorded lessons accompanied by workbook materials, was drafted, subjected to expert review, and revised. In the future, the program will be evaluated through use by teacher trainees enrolled in college level programs for teachers of the visually handicapped.

Task 9 Revision of the Chang Mobility Kit

Project Personnel Roy Brothers and Roger Huff

Purpose

One objective of the IMRC is to improve the quality of educational experiences afforded the visually handicapped. The initial development of educational materials has resulted from an assessment of needs identified through meetings of teacher experts, requests from the field, textbook analyses, and basic research. The usefulness of materials may be expanded after extended exposure and use with visually handicapped students. Reassessment and periodic follow-up activities which incorporate new techniques and approaches are necessary to improve existing educational products. In addition, the general appeal and overall effectiveness of instructional materials is enhanced through periodic revision and subsequent dissemination activities.

The present study focused on the Chang Mobility Kit (CMK) as it contributed to certain aspects of orientation and mobility (O&M) training and to its potential usefulness as an aid in the classroom. Specifically the purposes were: To substantiate mobility uses of the CMK; to list specific educational activities and/or teaching strategies which would be enhanced through the use of the CMK; and to assess the effectiveness of a revised CMK which includes suggested activities. This report describes only the first phase of the project, a questionnaire study to substantiate current use of the device.

Procedure

Phase one: Distribution of questionnaire. The purpose of phase one was to substantiate the usefulness of the CMK. Approximately 172 kits have been purchased, presumably by those directly involved in O&M instruction. Questionnaires were distributed to all those agencies or institutions which have purchased the kit. Uses for the kit were identified and suggestions were solicited for possible design changes which would result in an improved product.

As originally conceived there were certain advantages in using the kit. It was described: (1) as a device that would schematically represent the topography of a specific area, (2) as a time saving device in the sense that actual maps require painstaking construction, (3) as a portable device that provided for tactual inspection on the spot, and (4) as a highly adaptable device with potential for representing a variety of situations. The questionnaire determined the extent to which these features were in fact supported. Other questions were concerned with the effect of the CMK upon travel performance and concept attainment of the student.

Results

Questionnaires were sent to a total of 76 schools and/or school districts which had purchased one or more Chang Mobility Kits. Of this number 43% of the questionnaires were completed and returned. Directions specified that the questionnaire be completed by an instructor who had used the CMK with visually handicapped students.

Part I of the questionnaire dealt with general use of the kit. Since the users were primarily O&M specialists the students served were generally in the upper grades. Approximately 70% of the instructors reported its use with students in grades 9-12. About 40% reported use with students in grades 5-8, and 30% reported some use with students in grades 1-4 which was especially encouraging.

The kit was designed to be used on the street with students. Results indicated 24% used it in this manner, but 94% used it in the classroom. Approximately 12% reported its use in other locations.

As expected, all instructors had used the kit with individual students. Four of the respondents also reported its use with small groups of students. Their comments regarding the effectiveness of the group approach were generally positive. It was noted that first and second grade students reacted well to the concrete type materials and that the materials were most effective when small groups of children worked together to identify landmarks. Additional comments regarding general effectiveness of the materials were mixed. Comments ranged from "excellent" to "less effective" with congenitally blind youngsters.

Student manipulation of the pieces and student made maps were aspects of the materials use that apparently have not been emphasized. Only three of the respondents indicated that the CMK had been used regularly by the student to represent his concepts of an environment, nineteen indicated it had been used in this manner a few times, and eleven reported that it had never been used for this purpose. Those instructors who encouraged manipulation and student map making were quite positive about the value of the activity. In general, the student who constructed his own map of the area provided the instructor with additional evidence regarding successful task performance or conceptual deficits that were present.

It appeared that many of the instructors had preconceived notions about their students' ability to make their own maps and/or the value of such activity. Although they had never used the materials in this manner, they indicated their students would experience difficulty in the task. Comments were made to the effect that maps could be prepared more accurately by the instructor. It was also noted that the present kit did not contain sufficient materials for the students to make their own maps. The latter observation has implications for the development of new educational materials.

Part II of the questionnaire was devoted to more specific uses of CMK. The first question identified how the CMK was used. In approximately 29% of the cases the CMK was used to represent common travel problems (i.e. standard intersection, grid pattern, etc.). About 67% of the respondents indicated it was used to familiarize a student with a potential problem prior to actual travel, and 84% of the respondents reported it was used only after the student had experienced the situation in which he may or may not have had difficulty.

Lesson objectives listed were to:

1. provide an awareness of structure
2. integrate a tactual map with actual experience on the lesson
3. develop directional concepts
4. develop street and block relationships
5. develop compass relationships
6. introduce laterality and directionality
7. introduce directions and numbering systems
8. represent furniture arrangements
9. represent unusual situations (i.e. offset intersections, etc.)
10. supplement verbal directions and route planning

Approximately 61% of the instructors had used the kit to teach spatial relationships. Table 1 provides a list of examples reported and the frequency with which each was reported.

Table 1

Concepts Taught Using the Chang Mobility Kit

Concept	Frequency Reported
shapes of objects	5
parallel	4
cardinal directions	4
angles (right, dog-leg)	4
perpendicular	3
diagonal	3
offset	1
opposite	1
surrounding	1
adjacent	1
dead end	1
intersect	1
left - right	1
top - bottom	1
close - far	1
size	1
approximate distances	1
Total	34

In addition to these rather general concepts, there were eleven instructors who reported using the kit to illustrate rather specific locational relationships within the students environment. Examples were: the relationship of a room to stairs, rooms to hallways, blocks to corners, corners to corners, blocks to blocks (grid pattern), objects to objects, and blocks to streets.

It may be noted that over 40 spatial relationships were listed with the majority being basic concepts. Instructors attempting to use the kit have evidently found that the students lack fundamental spatial concepts. Consequently, they have been forced to teach these prerequisites before being able to use the materials in more advanced travel problems. One implication is that the classroom teacher might place greater emphasis on these concepts in preparing the student for formal orientation and mobility instruction. Once given specific guidelines or lesson plans, these same materials may be used by the classroom teacher quite effectively.

Since the pieces of the kit do not lend themselves to making scaled maps, the respondents were asked if this actually concerned them. Nine or 27.2% said yes, but 66.7% said no.

Respondents were asked to diagram three specific situations in which the CMK was used to alleviate or overcome an instructional problem. Table 2 provides a list of ten situations which were reported. It may be noted that teaching the configuration of a grid pattern was reported most often. The grid pattern should be considered as a prerequisite to understanding traffic patterns, pedestrian crossings, one-way traffic patterns, etc.

Table 2

Instructional Situations Diagrammed Using the CMK

Situation	Frequency Reported
Grid pattern	15
regular intersection	12
area representation	10
T - intersection	7
offset crossing	6
prerequisite concepts	6
traffic islands	3
cul de sac and/or dead end	5
curving streets	1
rotary	1

The examples reported of representing an area were shopping centers, a neighborhood area, campus buildings, the area around a school, and the locations of a bus stop within the block.

Examples of prerequisite concepts were parallel, right angles, right and left, shapes, similarities, differences, and cardinal directions.

Part III of the questionnaire dealt with modifications that might be considered for the materials. Approximately 61% of the users were not satisfied with the adhesive bond between the pieces and the hook velcro. This deficiency had been recognized and newer kits are being produced using a different and more effective epoxy material. Hopefully the deficiency has been overcome. Sixty-nine percent were satisfied with the general construction of the kit.

Tables 3 and 4 indicate the percentage of users satisfied and not satisfied with the size and variety of shapes in the kit. Follow-up questions focused on those responses which were negative.

Table 3

Modification of the CMK: Size of Pieces

	Frequency Reported	Percentage
Satisfied with size	13	39%
Not satisfied with size	14	42%
Not responding	6	18%

Table 4

Modification of the CMK: Variety of Shapes

	Frequency Reported	Percentage
Satisfied with variety of shapes and pieces	15	45%
Not satisfied with variety of shapes and pieces	12	36%
Not responding	6	18%

Of those 14 individuals not satisfied with the size of the pieces, 13 or 93% wanted smaller pieces. The remaining responses stated that the board should be larger which actually is a variation of the same response. Those reported as not satisfied with the variety of shapes were generally interested in additional pieces. Respondents recommended more long rectangles, smaller rectangles, pentagons, hexagons, smaller squares, and a special shape to represent stairs. It was also noted that there were too many large rectangles, triangles, and large squares. There were too few strips, medium sizes rectangles, and the smallest triangles.

Seven respondents were not satisfied with the thickness of the pieces. Of the seven, five preferred a thicker piece. This is not viewed as a problem since 58% of the users were satisfied with the thickness of the pieces.

A series of recommended modifications were identified for consideration.

1. small briefcase rather than strapped container
2. sample lesson plans for classroom teacher
3. smaller board for "on street use"
4. less awkward and lighter board
5. pictures of situations in a guide for teachers
6. pieces for 3 dimensional aspect (i.e. depth, texture)
7. small buildings, houses, trees, textures to represent different areas
8. market product with additional parts
9. use magnetic board

Part IV of the questionnaire called for a subjective evaluation of the kit. Not all respondents expressed their opinion. Sixty-four percent felt the CMK could be used to represent the topography of an area to the blind individual. Ninety-three percent felt the CMK was a time saving device in the sense that the preparation of comprehensive maps require a painstaking effort. Eighty-five percent thought that CMK was a versatile aid, adaptable to a variety of situations. Eighty percent felt a series of lesson plans for use with the CMK would increase its appeal as an educational aid. When asked to rate the CMK as an aid for orientation and mobility, 24% rated it very useful, 45% moderately useful, 31% limited in usefulness, and 0% not useful.

Subsequent activities

Results of the questionnaire study substantiated the usefulness of the CMK. Subsequent to this study, a group of experts was convened who wrote a manual of 18 lesson plans describing a variety of other classroom uses. At the same time, specifications for a revised CMK were written.

Sets of the revised kit together with the draft manual were reviewed in use with blind students by eight teachers of the blind in three residential schools. The kit and manual were further revised on the basis of these reviews. The final revision was submitted to APH for production and distribution.

Task 10 Adaptation of a recorded typing curriculum

Project Personnel Carson Nolan

Purpose

This project adapted the "Electronically Paced Typewriting Instruction for Blind Students" developed by Etier (1973) to increase its general applicability. Need for recorded typing materials for the visually handicapped has long been felt and was most recently voiced by the typing teachers interviewed in the study of the Phylab Brailler described previously in this report. The Etier curriculum, which was developed and field tested under USOE Contract No. OEC-6-72-0724 (509), was designed to utilize complex and expensive multiple-channel dictation equipment. Such equipment would not normally be available at most sites where blind children are educated. Consequently, it was decided to adapt the program so that commonly available auditory playback equipment could be used.

Materials

The curriculum is designed to teach students key board positions on the typewriter and then skill and speed in use of the key board. Key board positions are taught in a group setting through use of 10 45-minute tapes designed for this purpose. Once key board positions are learned, the program switches to individualized instruction. Sixteen tapes of syllable intensity suitable for instruction of blind students provide for skill development. Also of 45-minute length, these tapes present material which is systematically increased in speed from 4 to 72 words a minute (wam) and also in difficulty. Students work with each tape until a specified level of mastery is reached and then proceed to the next tape. The role of the teacher is to monitor constantly student performance and provide remedial instruction where required.

In the original version of the curriculum, the recordings were utilized in a classroom especially equipped with multiple-channel dictation equipment. In the adapted version, the first 10 lessons were reproduced in open reel tape recorded at 1 7/8 inches per second (ips) which could be played on the wide variety of open reel tape players commonly available. The 16 skill building lessons were reproduced on audio cassettes (C-60) recorded at 15/16 ips. This requires each student to have his own cassette player equipped with earphones. With the adaptation training of single isolated students was possible at reasonable cost.

Pages 24-92 of the project report were incorporated into a teachers manual. These materials were supplemented by expanded introductory information. A short review of the program, its history, purposes, and how it is applied was written and recorded in cassette form to serve as introduction to the program.

Method

The adapted program was subject to field trial in the spring of 1974 at the Arkansas School for the Blind and in the fall of 1974 at the Kentucky School for the Blind for periods of six weeks. At the end of these periods, informal interviews were held with the teachers to identify problems with the adapted materials.

Subjects

At the Arkansas School, students attempting the program included eight students in grade 5, one student in grade 4, and one ungraded student. Six students in junior and senior high school used the program at the Kentucky School.

Results

All students learned the key board positions using the first ten lessons. For some students individual lessons had to be repeated. All students were able to use the cassette recorders and recordings satisfactorily. All students showed some progress in skill development with the better students demonstrating typing speeds of 30 wam toward the end of training. The heavy headphones originally supplied the students at Arkansas proved too bulky and cumbersome and lighter earphones of the type commonly supplied with office dictation equipment were substituted successfully.

Conclusions

The adapted program appeared satisfactory and was submitted to the APH Educational Aids Committee for adoption. This program was accepted and will be manufactured and distributed for use with the visually handicapped.

Task 11 Development of an individual study screen

Project Personnel Amie Dennison and Ken Coy

Purpose

Many filmstrips and other visual educational materials exist that require projection and viewing at a distance. Distant viewing is not possible for many low visioned students. Near viewing of frontally projected materials is not possible because the student's head becomes interposed between the projector and the viewing screen.

The purpose of this project was to develop a light-weight, portable, inexpensive, rear viewing screen that would enable low vision students to use many projected visual materials successfully.

Materials description

The outside measurement of the aluminum frame of the screen is 11 1/2 x 14 1/2 x 3/8 inches. By means of a threaded metal rod and butterfly nuts, a 3/4 inch square wooden leg, six inches in length is attached to each lower corner of the frame. Each frame has packed with it a package of 25 sheets (11 x 14 inches) of Deitzen Professional Layout and Sketch Paper. This paper inserted in the frame becomes a screen for receiving the image from rear or front. Four pressure insert strips hold the screen in place. The overall weight of the frame and screen is only 10 oz.

The Individual Study Screen (ISS) can be used in a lighted room without bleaching color or line in the projected image. This means that note-taking, copy work, etc. is possible while having a clear vivid image for viewing in any position needed for the individual user. With the legs folded in a closed position (along side the frame) the students can hold or move the ISS to any angle that suits them. With the legs extended at an angle from the screen it becomes a self-supported front or rear projection screen.

If the ISS is set up so that the user views it from the front (as television is viewed) magnification of seven times can be achieved by placing the projector approximately 4 feet behind the ISS. This magnification is equivalent to that of 28 diopters. This form of rear-view projection makes it possible for the viewer to move as close as needed and to use additional aids such as hand magnifiers for more critical visual examination. A remote control cord is needed when the viewer works in this position. A smaller image is obtained if the projector is moved closer to the screen. The 7X is based on the ratio of size of slides to size of the ISS and the four feet is the approximate distance required to focus clearly an image which fills the screen.

When the rear view projection is being used, slides, filmstrips, etc. must be fed into the projecting equipment reversed from the normal position. If material being viewed has no right or left, it can be viewed successfully from both sides of the screen at the same time. For example, a low visioned child requiring magnification and close viewing can be positioned as explained above. At the same time a group of viewers with normal vision can see at four feet or more the images projected on the other side of the screen. They can also view at closer than four feet by sitting to either side of the projecting equipment.

Procedure

The need for the screen was identified through teacher request. During development, several models in varying sizes and of varying materials were constructed and subjected to informal test and review. The model described most nearly met the criteria of portability, lightness, and low cost.

Results

An Individual Study Screen was developed which met teachers criteria for usefulness. The screen was produced and distributed by APH. This screen is pictured and described in a brochure included in Appendix B.

Task 12 A manual to teach sound localization

Project Personnel Roy Brothers and Roger Huff

Purpose

Sound localization is the identification of the exact source of a sound. The sound may be located in reference to the observer's own position or to some other referent. Sound localization is an important factor in development of adequate mobility skills by severely visually handicapped students. A survey of orientation and mobility specialists revealed that procedures and materials for teaching sound localization were high among needs expressed.

A useful sound source, the Portable Audible Goal Locater (PAGL), is already under production at APH. The size and weight of this device permits easy manipulation of sound direction. Because of its unique sound, which can be varied in pitch, volume and frequency, it is readily discriminable in almost any environment. Development of a program to use this device in sound localization training seemed extremely desirable. This project was initiated to attain this end.

Procedure

The survey of mobility instructors gave general direction to the project. Subsequently, detailed specifications for an instructional manual were written by a group of orientation and mobility specialists assembled for this purpose: The following persons composed the group which met at APH for a three day period during April 1972.

M. Bernadette Alber, Resource Teacher of Visually Handicapped
Evanston Township High School, Evanston, Illinois

Ralph Brewer, Pre-School Counselor
Tennessee School for the Blind, Nashville, Tennessee

Gary Coker, Principal
Tennessee School for the Blind, Nashville, Tennessee

Will Evans, Dean of Students
Kentucky School for the Blind, Louisville, Kentucky

Robert Gockman, Orientation and Mobility Instructor,
Edward Hines Junior Hospital, Hines, Illinois

Ned Jackson, Orientation and Mobility Instructor
Illinois Braille and Sight Saving School, Jacksonville, Illinois

On the basis of these specifications, a draft manual was written by project personnel. Specific lesson sequences were used with small groups of visually handicapped students to examine their usefulness. The draft manual was next sent to the expert group for review. A revision of the manual based on these reviews followed.

Materials description

The manual is divided into two major parts. Part One describes group activities for development of sound localization skills while Part Two describes individual activities. Each part contains description of activities falling into four categories: (1) activities where the child is stationary and the sound source is also stationary, (2) activities where the child is stationary and the sound source is moving, (3) activities in which the child is moving and the sound source is stationary, and (4) activities in which the child is moving and the sound source also is moving.

Activities within each category represent a sequential development of skills. Activities increase in complexity as the child moves through the four categories and also as he moves from the beginning to the end of each category. This provision for category and activity sequences offers flexibility for the instructor in design of the sequence of experiences that are offered. It is possible for the teacher to make continuous observations of the child's skill level in the group activities and, where necessary, follow up with individualized activities where required. Casting many of the activities in the form of game makes them highly motivating.

Results

A manual to teach sound localization skills using the APH PAGL was developed. It was subsequently published by APH.

89